INITIALS ______ DATE ______

SOLID WASTE PROGRAM ROUTE SLIP

☐ **NEW APPLICATION**

	Initial / Date
Rick T.	
Pat C.	
Nancy (Proof)	
Cathy	
Jon D.	

☐ **NEW LICENSE**

	Initial / Date
Rick T.	
Pat C.	
Nancy (Proof)	
Carol	
Cathy	
Jon D.	

☐ **HEALTH OFFICER CARD**

	Initial / Date
Rick T.	
Carol	
Cathy	

☐ **INSPECTIONS**

	Initial / Date
Pat C.	
Nancy (Proof)	
Carol	
Jon D.	

☐ **INTERIM CLOSURES**

	Initial / Date
Rick T.	
Pat C.	
Nancy (Proof)	
Carol	
Cathy	
Jon D.	

☐ **CLOSURES**

	Initial / Date
Rick T.	
Pat C.	
Nancy (Proof)	
Carol	
Cathy	
Jon D.	

☐ **CHANGE IN LICENSE FOR FEE STATUS**

	Initial / Date
Rick T.	
Pat C.	
Nancy (Proof)	
Cathy	

☐ **COMPLAINTS**

	Initial / Date
Pat C.	
Nancy (Proof)	
Carol (filing & DBase)	

☒ **GENERAL CORRESPONDENCE**

	Initial Date
Pat C. / Rick T.	
Nancy (Proof)	CU 3-13
Jon D. (As Needed)	

☐ **MISCELLANEOUS**

	Initial / Date
Mailed	3/16/98

F:\USR\CB5453\WP\FORMS\ROUTE.SW

Fax — 543-5196

DEPARTMENT OF ENVIRONMENTAL QUALITY
PERMITTING & COMPLIANCE DIVISION
Community Services Bureau
Waste Management Section
MARC RACICOT, GOVERNOR

STATE OF MONTANA

Phone: (406)444-4400
Fax: (406)444-1374

Metcalf Building
1520 E Sixth Ave
PO Box 200901
Helena, MT 59620-0901

March 13, 1998

County Silver Bow
Facility & # Butte 20
[✓ Closure]
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Landfarm
Liner
Methane
O & M
Run - On
Other:
4-3

Jimmy Johnson
Director of Public Works
Butte-Silver Bow County
Courthouse
Butte, MT 59701

Dear Jimmy:

As we discussed on the phone, closed landfills can be irrigated to support their final end use. How else would we have soccer fields here in Helena? In order to prevent infiltration into the underlying waste, the water should be applied at agronomic uptake rates for the type of grass involved, minus the incident precipitation (i.e., turn the sprinklers off when it is raining and only use enough to keep the grass growing). The local National Resource Conservation Service office or County Extension Agent should be able to help you in determining what the rate of water application should be.

If you have any further questions on this matter, please feel free to contact me. My direct phone line is 406-444-5294.

Sincerely,

Pat Crowley

F. Patrick Crowley
Acting Section Supervisor

File: Old Butte landfill\closure
Path: CB5403\wp\landfill\closure\BSB\watering

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE: 3-13-98

NUMBER OF PAGES (INCL. COVER) 2

TO: JIMMY JOHNSON

FAX NUMBER: 543-5196

FROM: FPAT CROWLEY

COMMENTS: HARD COPY TO FOLLOW

MDEQ FAX NUMBER: (406) 444-1374

IF YOU DO NOT RECEIVE ALL THE PAGES OF THIS FAX TRANSMISSION, CALL THE SENDER AT (406) 444-.
THANK YOU!

FAXED 3-13-98

INITIALS____ DATE ____

SOLID WASTE OUTGOING CORRESPONDENCE ROUTE SLIP (ONLY)

☐ **NEW APPLICATION** **Initial / Date**
Rick T. ____________
Pat C. ____________
Nancy (Proof) ____________
Cathy ____________
Jon D. ____________

☐ **NEW LICENSE** **Initial / Date**
Rick T. ____________
Pat C. ____________
Nancy (Proof) ____________
Carol ____________
Cathy ____________
Jon D. ____________

☐ **HEALTH OFFICER CARD** **Initial / Date**
Rick T. ____________
Carol ____________
Cathy ____________
________ ____________

☐ **INSPECTIONS** **Initial / Date**
Pat C. ____________
Nancy (Proof) ____________
Carol ____________
Jon D. ____________

☐ **INTERIM CLOSURES** **Initial / Date**
Rick T. ____________
Pat C. ____________
Nancy (Proof) ____________
Carol ____________
Cathy ____________
Jon D. ____________

☐ **CLOSURES** **Initial / Date**
Rick T. ____________
Pat C. ____________
Nancy (Proof) ____________
Carol ____________
Cathy ____________
Jon D. ____________

☐ **CHANGE IN LICENSE FOR FEE STATUS** **Initial / Date**
Rick T. ____________
Pat C. ____________
Nancy (Proof) ____________
Cathy ____________

☐ **COMPLAINTS** **Initial / Date**
Pat C. ____________
Nancy (Proof) ____________
Carol (filing & DBase) ____________

☑ **GROUND WATER** **Initial / Date**
Nancy (Proof) ND 5/20/97
Pat C PPC 5/20/97

☐ **GENERAL CORRESPONDENCE** **Initial / Date**
Pat C. / Rick T. ____________
Nancy (Proof) ____________
Jon D. (As Needed) ____________
Mark Steger Smith (As Needed) ____________

☐ **MISCELLANEOUS** **Initial / Date**
____________ ____________
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Mailed 5/20/97 ND

☐ **FILE** ____________
____

F:\USR\CB5453\WP\FORMS\ROUTE.SW

DEPARTMENT OF ENVIRONMENTAL QUALITY
PERMITTING & COMPLIANCE DIVISION
SOLID WASTE PROGRAM
MARC RACICOT, GOVERNOR
Metcalf Building
STATE OF MONTANA
Phone: (406)444-4323
Fax: (406)444-1374
PO Box 200901
Helena, MT 59620-0901

May 20, 1997

County Silver Bow
Facility & # Butte # 20
[✓ Closure]
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Other:
4-3
Landfarm
Liner
Methane
O & M
Run - On

Jimmy Johnson
Director of Public Works
Butte-Silver Bow
Courthouse
Butte, MT 59701

Dear Jimmy:

I have reviewed the draft design drawings for the passive methane gas extraction system at the Old Butte-Silver Bow landfill. The system appears to meet standard design criteria for these types of systems. The use of PVC piping is acceptable, however above ground piping should be painted with a UV inhibitive paint to prevent deterioration. This material is also sensitive to cold temperatures and may shatter on impact below 40° F. The design also appears to meet the preferred remedy presented in the Corrective Measures Assessment and is approved for that purpose. Please notify the Department when the installation is completed so we can "start the clock" on tracking the effectiveness of the selected remedy.

The May 13, 1997 letter from Pioneer also indicates that the placement of the final cover at the landfill is going to begin soon and indicates that the January 1996 Construction Quality Assurance Plan would be followed. This plan has been subsequently modified and added to by information contained in the Final Construction Quality Assurance Plan for the Clark Tailings Waste Management Area dated April, 1997. The information on the test pads and the Hollow borrow source indicates that material will make an acceptable cap for the landfill. This work does not need to be duplicated. The Departments telephone comments to Pioneer on the January 1996 Plan are answered in the April 1997 Plan and are incorporated by reference. My April 29, 1997 letter giving written approval of

the CQA Plan was intended for both the Old Landfill and the Clark Tailings.

If you have any questions on this matter, please feel free to contact me, my direct line is 406-444-5294. Otherwise, see you in Butte, soon.

Sincerely,

F Patrick Crowley

F. Patrick Crowley
Acting Program Manager

cc: Chuck Stillwell, ARCO; Ron Bertram, EPA; Neil Marsh, MDEQ; Brad Archibald, Pioneer.

File:Old Butte Landfill/closure and Corrective Measures files.
Path: CB5403\wp\landfill\closure\butte\methane

Anaconda
Montana

Chuck Stilwell
Ph: (406) 563-5211, Ext. 413

4/13/00

Pat,

Thought you'd be interested in a presentation and paper done at the 2000 Billings Reclamation Symposium on the Clark Tailings

Let me know what you think

Sincerely,
Chuck Stilwell

2000 BILLINGS LAND RECLAMATION SYMPOSIUM

ALTERNATIVE MINE WASTE REPOSITORY DESIGN TO ALLOW FOR REDEVELOPMENT AND REUSE OF LAND IN BUTTE, MONTANA

RECEIVED

APR 19 2000

MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Chuck Stilwell, P.E. and Brad Archibald, P.E.[1]

ABSTRACT

Reclamation of mine waste areas and design of mine waste repositories and covers must take into consideration regulatory, technical, and end-use issues. Presented here is a case study of a site in Butte, Montana, where a unique approach was taken to design and construct a mine waste repository and municipal landfill that met all regulatory requirements while allowing the redevelopment of the site into a multi-functional recreational complex for the community.

The Clark Tailings were a historic tailings impoundment approximately one mile southwest of Butte, Montana. The 60-acre (24-hectare) site contained approximately 1,000,000 cubic yards [yd^3] (765,000 m^3) of mine waste and is adjacent to the old Butte municipal landfill. A combined remedy for the mine waste and landfill was performed under RCRA jurisdiction. Also, 850,000 yd^3 (650,000 m^3) of mine waste from another site in Butte were consolidated at the site. The waste placement and repository cover designs considered plans for future redevelopment into a recreational complex, which included large irrigated areas for turf-grass ballfields, play areas, Park buildings, and parking areas. Though the cap was designed to meet the prescriptive regulatory requirements, many alternative features were incorporated, including using locally available soil to meet strict infiltration barrier requirements. Waste placement and the final cover were designed in 1997 and constructed in 1997 and 1998. Park improvements are scheduled for construction in 1999 and 2000.

Introduction

A combination of conditions and concerns related to several/mine waste reclamation projects and a recently closed, previously used municipal solid waste landfill near Butte provides an opportunity for a creative solution to all. This paper describes how the challenge of cleaning up two sites, a mine waste site and a landfill in an urban setting, while creating a recreational amenity for the community in the process was met.

---

[1] Chuck Stilwell, Environmental Manager, ARCO Environmental Remediation, L.L.C, 307 East Park Street, Suite 400, Anaconda, Montana 59711, and Brad Archibald, Senior Engineer, Pioneer Technical Services, Inc., P.O. Box 3445, Butte, Montana, 59702

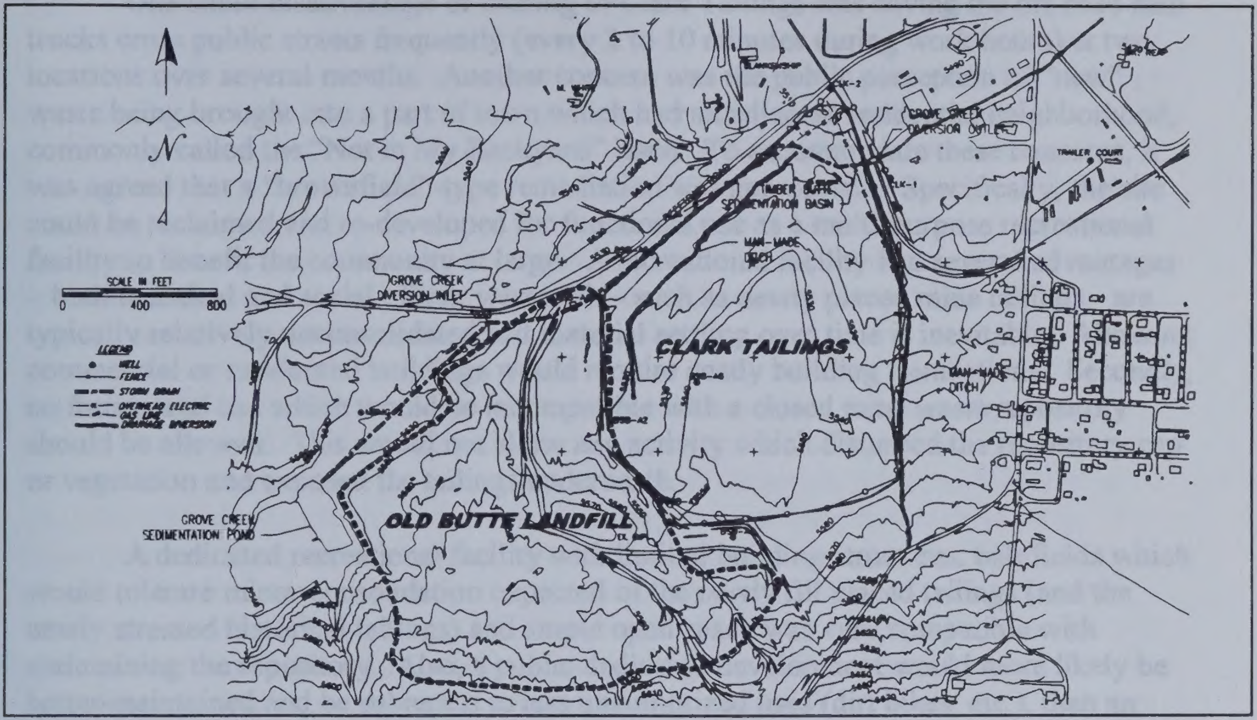
Background

The Clark Tailings, located in southwest Butte, are wastes generated by the William Clark's Timber Butte zinc mill, operated between 1914 and the 1930s. The historic tailings impoundment containing approximately 1,000,000 yd^3 (765,000 m^3) of tailings on a 60 acres (25 hectares) site was partially reclaimed in the mid-1980s, but concerns remained regarding their possibility to impact the surrounding area. The once remote site, now has residential and light industrial development adjacent to it, and was to be studied to determine the need for further, more permanent reclamation.

Adjacent to the west of Clark Tailings was the old Butte municipal landfill, operated between the 1960s and 1995. Groundwater contamination detected in 1994 precipitated a Corrective Measures Assessment for the landfill. The landfill was closed in the mid-1990s in accordance with applicable Subtitle D regulations. The closure included a soil cover and grading to achieve positive drainage from the waste areas, the surface revegetated with native grasses, and a landfill gas venting system installed to mitigate groundwater contamination present beneath and downgradient of the landfill. Though the closure was complete, no foreseeable active land use was likely - as with many closed municipal landfills - due to the uncompacted fill, methane generation and site maintenance issues.

A second area impacted by mine waste called the Lower Area One (LAO) site was located one mile north of the Clark Tailings and Butte landfill sites. Approximately 1.2 million yd^3 (917,000 m^3) of tailings were to be removed from a historic floodplain and wetland setting, which was causing significant metals impacts to the Silver Bow Creek surface and groundwater. LAO was in the process of being remediated, which involved an action of removing much of the accessible tailings from the Silver Bow Creek floodplain for a span of about a mile of the stream and disposed of them via rail 25 miles away in the Opportunity tailings ponds, near Anaconda, MT. The LAO tailings removal was already underway, with approximately 400,000 yd^3 of dry, unsaturated tailings already moved to the Opportunity Ponds. What tailings remained was to take up to six years to remove and haul, given the originally selected mode of transportation - rail. This lengthy construction schedule was due specifically to lack of rail car availability and capacity and the distance and time to haul 25 miles away. Under isolated conditions, a six-year project length could have been accommodated. Yet in the case of LAO, this project's schedule was interrelated with other planned remediation in the Butte area. If the LAO project took another four to six years to complete, the Butte area clean-up effort would likely have been delayed the same length of time.

Finally, an unrelated need existed in Butte - Butte had a lack of modern community recreational facilities. The prospect of a publicly funded facility was unlikely due to an uncertain economic tax base similar to many Montana communities. By working together, ARCO, which was performing much of the reclamation in Butte Butte's local government, State, and Federal Agencies overseeing mine waste and landfill reclamation, conceptualized a creative solution to these issues.


N
SCALE IN FEET
0
400
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LEGEND
WELL
FENCE
STORM DRAIN
OVERHEAD ELECTRIC
GAS LINE
DRAINAGE DIVERSION
GROVE CREEK DIVERSION INLET
TIMBER BUTTE SEDIMENTATION BASIN
MAN-MADE DITCH
GROVE CREEK DIVERSION OUTLET
TRAILER COURT
CLARK TAILINGS
MAN-MADE DITCH
OLD BUTTE LANDFILL
GROVE CREEK SEDIMENTATION POND

Figure 1. Pre-Remediation Site Map.

Conceptual Plan

The prospect of a protracted remediation schedule at LAO if the Opportunity Ponds disposal site continued to be used initiated a study to find a closer alternative repository site which would be environmentally acceptable for the long-term and would allow a safe haul operation during construction. Though several sites were potentially available near Butte, Clark Tailings provided several advantages, including:

- proximity (approximately one mile away from LAO);
- a likely off-road large truck haul route (for safe haul off public roads using high capacity 35-50 ton trucks);
- shorter schedule (hauling in 35-ton trucks to Clark Tailings would allow the LAO tailings removal and disposal to be completed in two years); and
- the possibility of combining the closure of the partially reclaimed Clark Tailings at the same time as the LAO remediation.

Several advantages also existed in reclaiming the Clark Tailings and Butte's old landfill as a consolidated waste management unit. The landfill had impacted groundwater downgradient of the site, and there were elevated metals in the groundwater downgradient of the Clark Tailings. Closing, monitoring, and managing the groundwater impacts as part of a consolidated waste management unit offered a efficient and effective solution to both of the groundwater issues.

One small disadvantage of hauling to Clark Tailings was having the off-road haul trucks cross public streets frequently (every 2 to 10 minutes during work hours) at two locations over several months. Another concern was the public perception of "new" waste being brought into a part of town which had an adjacent residential neighborhood, commonly called the "Not in My Backyard" issue. To accommodate these concerns, it was agreed that a "brownfield"-type remediation was appropriate. Specifically, the site could be reclaimed and re-developed for functional use as a multi-purpose recreational facility to benefit the community at large. A recreational facility had several advantages – both technical and social. First, waste fills - such as newly placed mine tailings - are typically relatively unconsolidated and material settling over time is inevitable. Allowing commercial or residential buildings would require costly building foundations. Secondly, no future land use which would be incompatible with a closed mine waste repository should be allowed. This would not allow any activity which disturbed the repository cap or vegetation and exposed the tailings underneath.

A dedicated recreational facility with limited building structures, ball fields which would tolerate minor consolidation expected of the newly fill placed tailings (and the newly stressed historical tailings) and ample open space was very compatible with maintaining the repository. Also, a public dedicated development would more likely be better-maintained and be subjected to less unauthorized uses (dirt bikes, etc.), than an inactive and fenced repository. Finally, the recreational facility, or Park, in itself offered the community a new, modern public amenity. The combined repository/closed landfill/park idea was formalized in a Conceptual Plan, which was conditionally approved by the representative Agencies as long as the regulatory requirements for both landfill and mine waste repository closures were met.

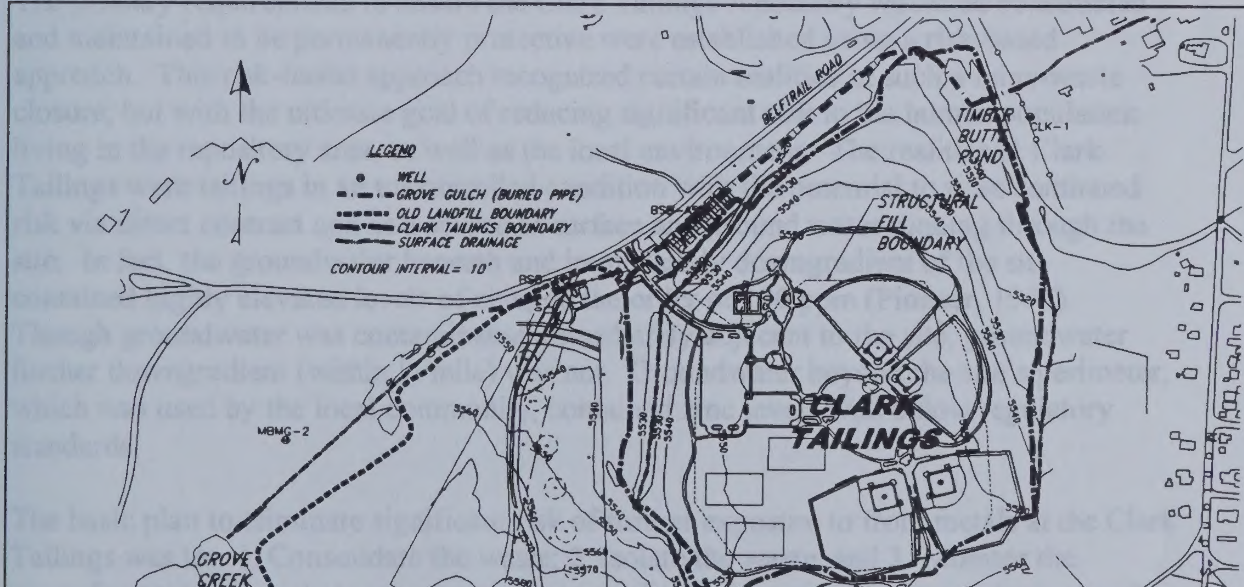
N
LEGEND
WELL
GROVE GULCH (BURIED PIPE)
OLD LANDFILL BOUNDARY
CLARK TAILINGS BOUNDARY
SURFACE DRAINAGE
CONTOUR INTERVAL= 10'
BEEFTRAIL ROAD
TIMBER BUTTE POND
CLK-1
STRUCTURAL FILL BOUNDARY
CLARK TAILINGS
SOUTH POND
MBMG-2
GROVE CREEK SEDIMENT POND
SCALE IN FEET
0
280
560
OLD LANDFILL

Figure 2. Site map for Post-Remediation with Park Features shown.

One small disadvantage of hauling to Clark Tailings was having the off-road haul trucks cross public streets frequently (every 2 to 10 minutes during work hours) at two locations over several months. Another concern was the public perception of "new" waste being brought into a part of town which had an adjacent residential neighborhood, commonly called the "Not in My Backyard" issue. To accommodate these concerns, it was agreed that a "brownfield"-type remediation was appropriate. Specifically, the site could be reclaimed and re-developed for functional use as a multi-purpose recreational facility to benefit the community at large. A recreational facility had several advantages - both technical and social. First, waste fills - such as newly placed mine tailings - are typically relatively unconsolidated and material settling over time is inevitable. Allowing commercial or residential buildings would require costly building foundations. Secondly, no future land use which would be incompatible with a closed mine waste repository should be allowed. This would not allow any activity which disturbed the repository cap or vegetation and exposed the tailings underneath.

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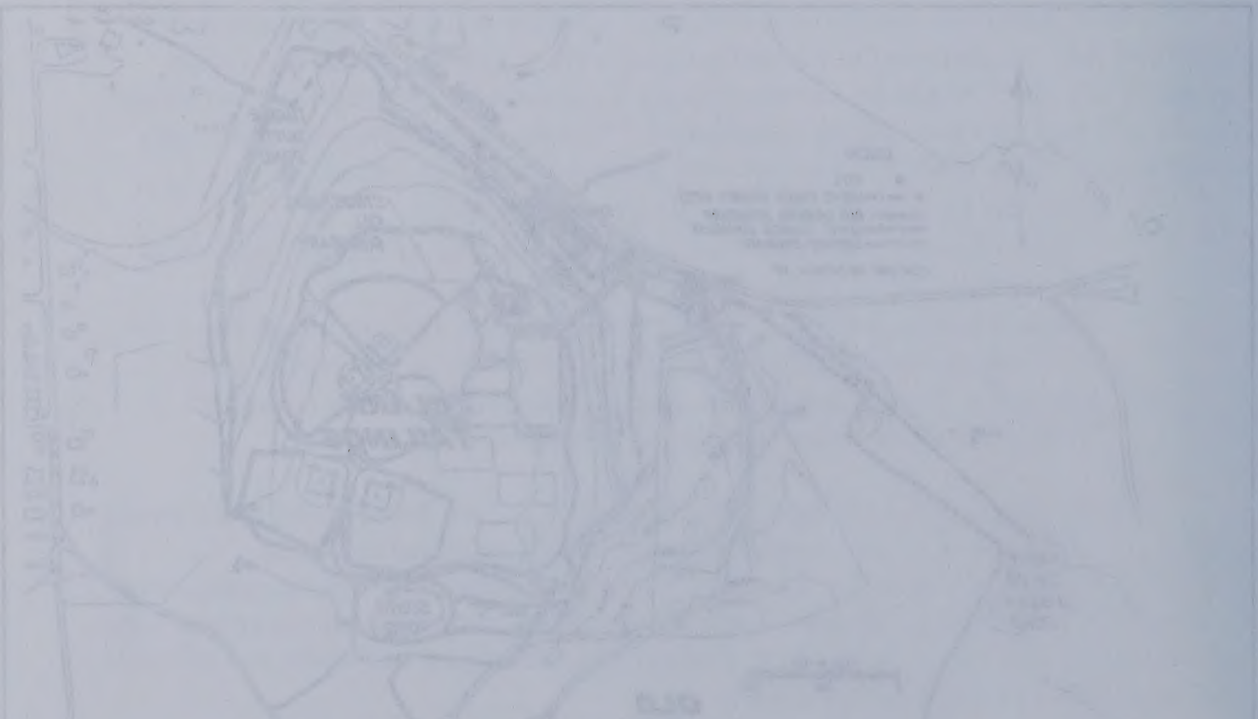

Figure 2. Site map for Post-Remediation with Park Features shown.

Repository and Park Design

With the Conceptual Plan set to build a recreational facility at the Clark Tailings once the Colorado Tailings from LAO were placed there, detailed design of the repository could begin. Designing a tailings repository cap before all the tailings materials are placed and knowing its end land use offered many advantages to having to close an existing tailings pond which was created during a mine processing facility's operation. To integrate the recreation facility's (Park's) design and repository design, both the primary repository design requirements (and objectives) and Park design features had to be understood.

Repository Design Requirements - Primary requirements for the repository were established by the Montana Department of Environmental Quality's Solid Waste Program (MDEQ/SW) who regulates municipal and hazardous waste repositories in Montana. The MDEQ/SW was also the authority overseeing the old Butte landfill's closure, adjacent to the Clark Tailings. Two memoranda of agreement between federal Environmental Protection Agency (EPA) and MDEQ/SW (EPA, 1995 and MDHES, 1995) transferred the Superfund (CERCLA)[2] authority to the MDEQ/SW related to placing LAO's tailings at Clark Tailings and closing the old Clark Tailings as a consolidated waste facility closure with the old Butte Landfill. All solid and hazardous waste regulatory requirements had to be met in this consolidated closure. The presence of groundwater contamination dictated the need for a Corrective Measures Assessment (Pioneer, 1997) for the combined site. The assessment included developing a closure plan to show which requirements must be met and how they were to be achieved.

The primary requirements to ensure the Clark Tailings repository would be constructed and maintained to be permanently protective were established using a risk-based approach. This risk-based approach recognized certain realities of such a mine-waste closure, but with the ultimate goal of reducing significant risk to the human population living in the repository area, as well as the local environment. The realities at Clark Tailings were tailings in an uncontrolled condition with the potential to pose continued risk via direct contract and as a source of surface and ground water running through the site. In fact, the groundwater beneath and immediately downgradient of the site contained highly elevated levels of zinc, on the order of 100 ppm (Pioneer, 1997). Though groundwater was contaminated immediately adjacent to the site, groundwater further downgradient (within ¼ mile) was not. Groundwater beyond the site's perimeter, which was used by the local community, contained zinc levels well below regulatory standards.

The basic plan to eliminate significant risk of further exposure to from metals at the Clark Tailings was to: 1. Consolidate the waste; 2. Isolate the waste; and 3. Monitor the groundwater to show that groundwater downgradient of the site does not get worse and shows steady improvement over time. The specific design features needed to achieve this plan are summarized below:

---

[2] Comprehensive Environmental Response Compensation Liability Act, 1980

1. Consolidate the Waste – Tailings from LAO and historic Clark Tailings, which had been spread out at the site by wind and water, were to be consolidated in a main repository within the existing "foot-print" of the Clark Tailings Site. This foot-print was approximately 60-acres (24 hectares), and contained an estimated 1,000,000 yd^3 (765,000 m^3) of consolidated tailings. The new repository at Clark Tailings has a 53-acre foot-print.

2. Isolate the Waste – Isolating the waste from exposure pathways was the primary challenge that was to be met. The waste had to be isolated to prevent further exposure to surface water or groundwater flowing near and through the site. This was done through meeting several design objectives:

a. Cap the Waste with Engineered "Prescriptive" Cover – Once consolidated, the approximately 1,850,000 yd^3 (1,414,000 m^3) of waste must be capped with cover intended to isolate the waste from surface exposures via direct contact of the waste, and more importantly, mitigate the potential for further infiltration of water to and through the waste. This was to be achieved with an engineered cover intended to meet the technical requirements determined in the Corrective Measures Assessment and the prescriptive requirements of RCRA and related MDEQ/SW regulations. The cap consists of a multi-layered soil and geosynthetic cover, that limited infiltration, as shown on Figure 3. The layers included from the top down: a. 18 inches of topsoil (fine-textured, locally available soil) to allow vegetated growth; b. geotextile, which is a non-woven, needle-punched fabric intended to keep fine-grained materials from penetrating from the cover soil into the gravel layer; c. 4.5 inch gravel layer to allow any water infiltrating through the topsoil to freely drain laterally off the site, rather than continue infiltrating vertically and to provide a capillary break, increasing the water-holding capacity of the overlying topsoil and preventing the upward migration of acid from the underlying tailings; d. infiltration barrier consisting of 18 inches of native clay/silt materials with a maximum hydraulic conductivity of 1×10^{-7} cm/sec to reduce further infiltration; and e. compacted, low permeability tailings material of depths varying from 2 to 20 feet, which in itself deters significant water infiltration.

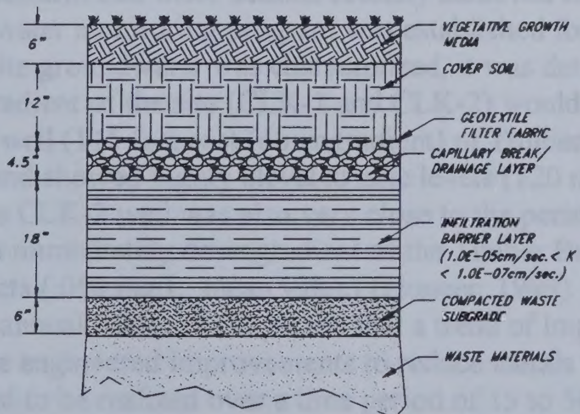

Figure 3. Typical Cap Cross-Section.

b. Control Surface Water Run-on and Run-off – By managing the surface water flowing onto the site so that it does not contact the waste or is allowed to collect and infiltrate into the waste, surface and groundwater exposures are largely cut off at the site. Historically, surface water flowing off of Timber Butte above the site was allowed to flow onto the Clark Tailings, washing the tailings via surface erosion and infiltrating to exacerbate poor groundwater quality conditions. Under the closure plan, all surface water running on the site would be routed around the perimeter of the repository via lined open channels. All surface water generated from precipitation falling on the site would be routed to these same channels.

c. Clean and Line Timber Butte Sediment Pond – A primary suspected pathway of historic groundwater contamination was an unlined sediment pond which collected all run-off from the Clark Tailings before it entered the surface drainage, Grove Gulch, running adjacent to the site. The unlined pond collected surface water and sediment with elevated metals from the site and likely allowed active infiltration to the downgradient groundwater. The only downgradient well in which groundwater quality standards were exceeded was directly downgradient of this pond. By controlling run-on and run-off of surface water and capping tailings to eliminate water from direct tailings exposure, the water reaching the Timber Butte sediment pond would be of much-improved quality. By cleaning out existing sediment and consolidating it into the new repository, then lining the pond, a significant source of infiltration of poor quality water would be likely eliminated.

d. Site Grading – Positive drainage was required for the entire final surface of the repository to promote run-off of precipitation on the site. Also, a maximum of 4:1 (horizontal to vertical) surface grade was allowed to ensure the revegetated surface would not be subjected to significant erosion and final slopes were stable under static and dynamic conditions. As further discussed below under Park Design, the design team was able to work within those grading constraints to develop a functional and aesthetically pleasing Park design.

3. Monitor the Groundwater – The two major engineering actions of consolidating and isolating the wastes are intended to eliminate future pathways of surface and groundwater contamination. To confirm that these actions actually achieved their objectives, a simple yet effective groundwater monitoring program was established for the site. After all surrounding and onsite groundwater was characterized, it was determined that two wells immediately downgradient of the site (CLK-1 and CLK-2) would be monitored. CLK-1 well was the closest well (115 feet east (downgradient) of Timber Butte Pond/Clark Tailings boundary) and showed highly elevated zinc levels (120 mg/L, mean value) (Pioneer, 1999). The CLK-2 well was also very close to the perimeter of the Clark Tailings, but was not immediately downgradient of the Timber Butte Pond. It showed much less zinc impacts (.050 mg/L, mean value) (Pioneer, 1999). By monitoring these two wells on a semi-annual basis, it is expected that a trend of improvement will be established, given the engineered improvements to reduce metals flux to the groundwater. This trend is expected to be realized over a time period of 15 to 50 years, given the hydrogeologic setting that dictates groundwater velocities and flow. These time frames

to allow improvement are acceptable, since the groundwater under or immediately adjacent to the site would not be available for use and all groundwater data further downgradient showed no exceedences of groundwater quality standards, as mentioned above.

These primary design features were laid out in a detailed repository design and constructed as the haul and disposal of LAO tailings at the Clark Tailings was completed between 1997 and 1998.

Other Repository Design Elements

In the completion of the repository at Clark Tailings several unique or site-specific variations on the primary design were used which both met the design's requirements and offset some of the additional costs of constructing the repository to allow a Park to be built on it.

Infiltration Barrier Material - The specification for the infiltration barrier was meeting or exceeding a $1x10^{-7}$ cm/sec permeability requirement. Normally, this specification is met using a natural true clay material or a geomanufactured geosynthetic product. With Clark Tailing's new repository size (49 acres) and barrier layer depth (18 inches), a volume of approximately 120,000 yd^3 (74 ac-ft) of natural clay or geosynthetic clay (GCL) liner material would have been required. Given the geology around Butte, little or no large sources of true clay exist, but there was a silt-clay material that had the potential as a low-permeability material. A procedure to test the locally-available silt-clay was approved by MDEQ/SW, so that the infiltration barrier specification could be met using the available silt-clay material. The ability to use the locally-available material, rather than importing natural clay or purchasing a geosynthetic liner product, saved the project approximately $500,000.

Parking Lot as Barrier – Knowing the Park layout as the repository was being designed offered several advantages. An important example of this was allowing a variation to the infiltration barrier layer of the cap in the 2.3 acre area where the Park's main parking lot was to be located. The parking area, with its asphalt cover, would be impervious to infiltration; therefore, the normal infiltration layer was not required under the parking lot area.

Park Design

Once it was decided a park would be the permanent future use of the new Clark Tailings repository, a detailed design for the Park which was fully integrated with the repository design was required. Being able to design the Park prior to the completion of the repository allowed for more effective integration of repository's and Park's designs. Though there are numerous examples of this, several of the more important integration elements are discussed here.

Park Grading, Landform – One of the most important issues in integrating the Park's design with the repository was the placement, shaping and grading of the tailings within the repository to accommodate the needs of the Park. The primary landform need of the

Park was a large, relatively flat surface where the ballfields, parking lot, and support facilities would be located. In its existing condition, the Clark Tailings had only a few contiguous flat acres, and being on the side of the Timber Butte hill this offered an interesting challenge. To achieve a relatively flat area for the primary Park area of approximately 25 acres, the repository's design had to include a fairly precise fill and grading plan for the tailings imported from LAO. The repository "fill plan" generally provided that a 25 acre bench would be created with fill depths (all requiring 90% compaction to minimize differential setting) of up to 20 feet at the northern edge of the site. In addition, the tailings had to be placed in some locations to be a suitable foundation for buildings and other structures. These structural fill areas were identified in advance and only tailings with the material strength to hold structures were placed there.

A second design objective related to the grading of the repository was creating a landform which was more natural-looking than the conventional engineered repository. Often repositories, as with many engineered earthworks, have square or rigid planforms, 3:1 side slopes and a flat top. Though the Clark Tailings repository needed to be relatively flat for the Park's design, the side slopes which generally faced northeast toward the town were designed to be more natural-looking and blend into the surrounding landscape. A basic maximum slope of 4:1, instead of 3:1, was chosen. Then actual slopes on the northeast side (the most visible side) were varied from 4:1 to 10:1, interjecting some subtle ridges and depressions extending from top to bottom of the slopes. The subtle ridges and depressions offer a more natural foothill-looking landform as well as ultimately allowing vegetation to mature with more diversity given a slight variation of water availability from the ridges to the depressions.

Park Structures and Cap Penetrations – The Park's design called for several buildings, shelters, five ballfields with associated fences and backstops, and other minor structures which all required foundations. These foundations, as well as the necessary underground utilities, required construction at depths below the ground level within the repository's cap. For all Park construction requiring cap penetration, a design was required which provided a retrofit around the penetration with an equivalently protective cap. Figure 4 shows one such design for a fence post.

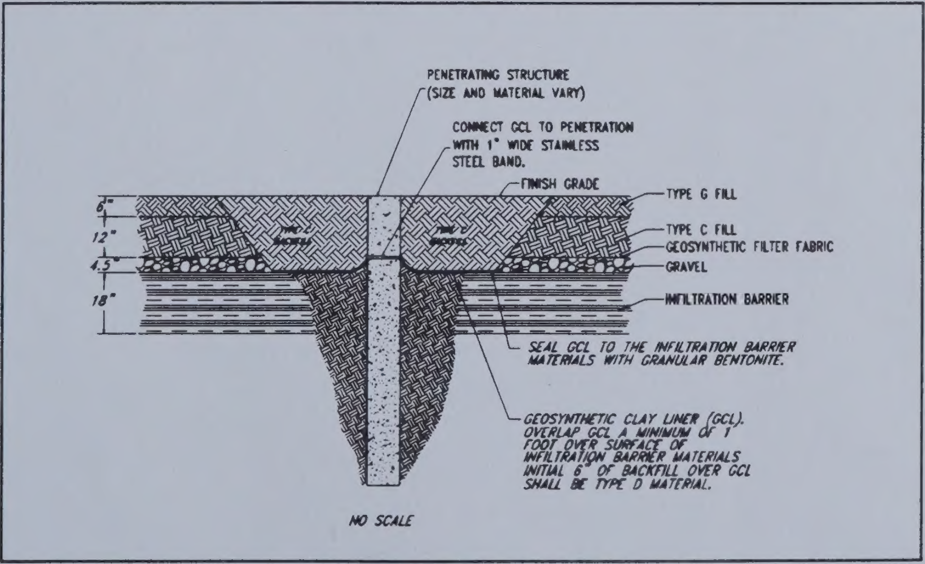
PENETRATING STRUCTURE (SIZE AND MATERIAL VARY)
CONNECT GCL TO PENETRATION WITH 1" WIDE STAINLESS STEEL BAND.
FINISH GRADE
TYPE G FILL
TYPE C FILL
GEOSYNTHETIC FILTER FABRIC
GRAVEL
INFILTRATION BARRIER
SEAL GCL TO THE INFILTRATION BARRIER MATERIALS WITH GRANULAR BENTONITE.
GEOSYNTHETIC CLAY LINER (GCL). OVERLAP GCL A MINIMUM OF 1 FOOT OVER SURFACE OF INFILTRATION BARRIER MATERIALS INITIAL 6" OF BACKFILL OVER GCL SHALL BE TYPE D MATERIAL.
6"
12"
4.5"
18"
NO SCALE

Figure 4. Typical Cap Penetration (example shown for a fence post).

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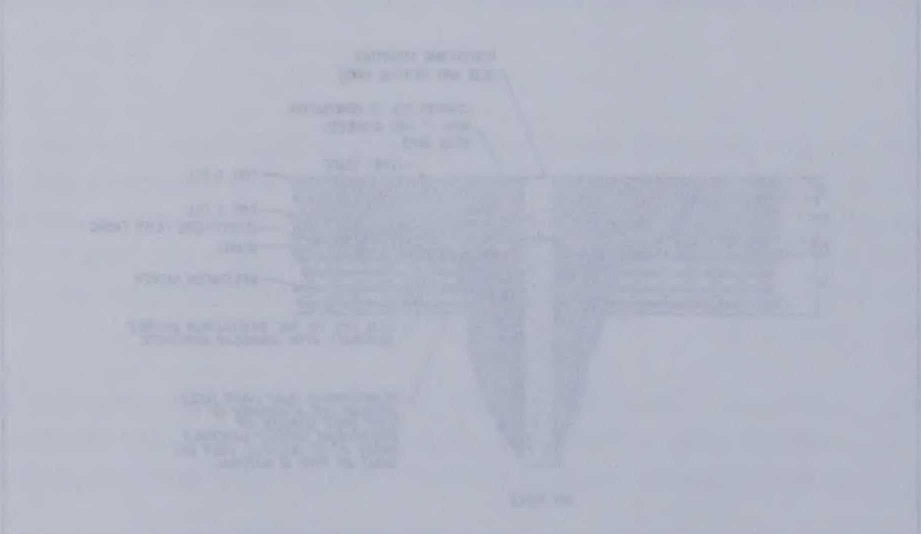


Figure 4. Typical Cap Penetration (example shown for a fence post).

Use of Adjacent Landfill in Park Design – Though the primary Park elements were designed to be on the new Clark Tailings repository, Butte's closed municipal landfill adjacent to the site was integrated into the Park's design. Given its unconsolidated and unlevel fill, its suitability was limited. Yet, it was generally acceptable as a landing area for a golf driving range. With appropriate grading and infrastructure design of tee areas where the public would access, a golf driving range was designed as a compatible future option to the Park.

Summary

By planning and designing the Park in tandem with the repository, they could be integrated and coordinated much more effectively and efficiently. The repository was constructed as designed between 1997 and 1998. The Park will be constructed between 1999 and 2000. The Park will be available for community use by spring of 2001. Groundwater monitoring to track the groundwater's quality at the downgradient edge of the site will continue to ensure the repository remains protective of the aquifer downgradient of the site.

This project provides an example of how industry, a community, and regulatory agencies can coordinate well to successfully meet an environmental challenge. Though the circumstances described herein precipitating the creation of a municipal Park from an old mine tailings area was somewhat unique, many of the technical designs and regulatory decisions leading to the successful redevelopment of Clark Tailings mining site are applicable elsewhere.

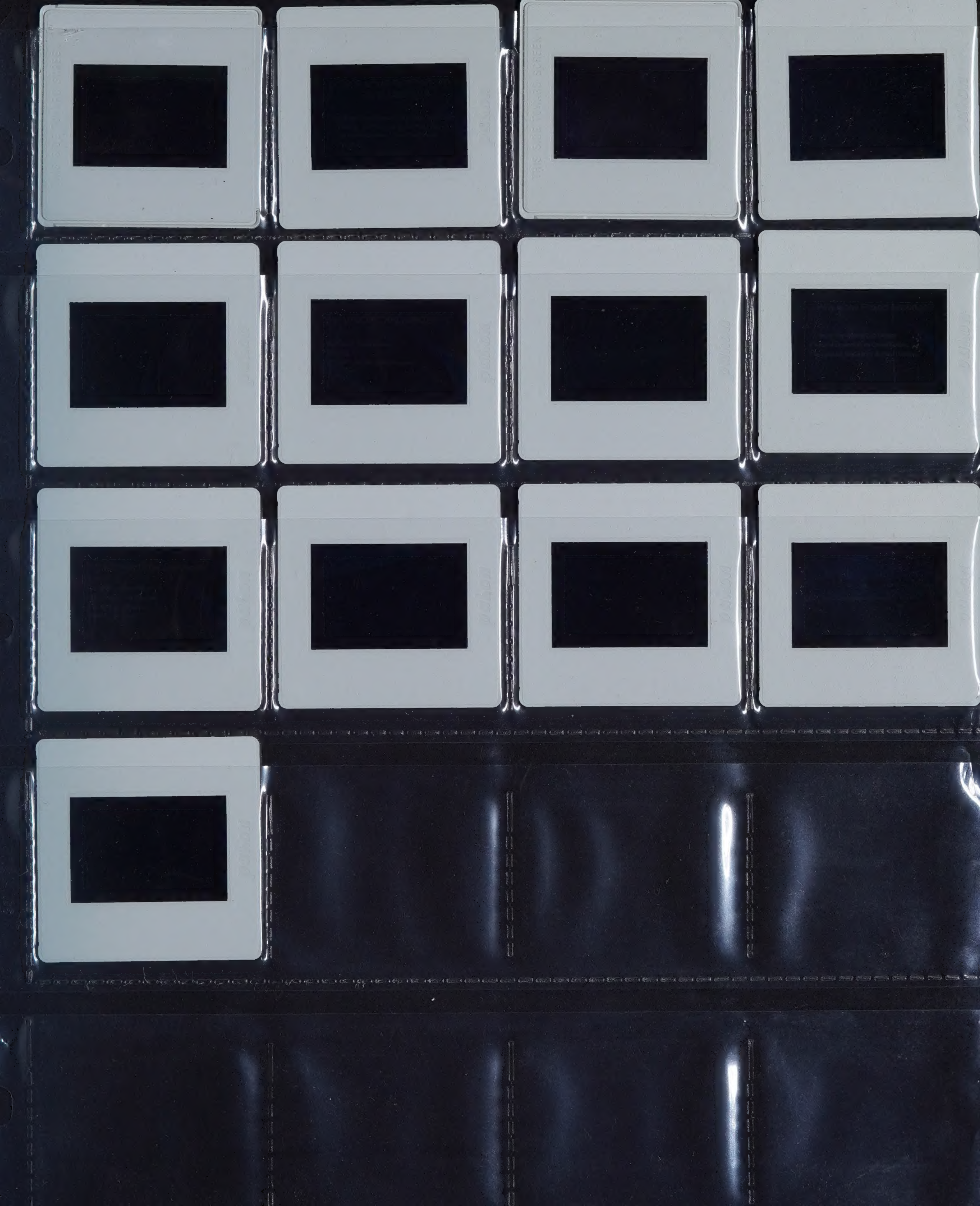
REFERENCES

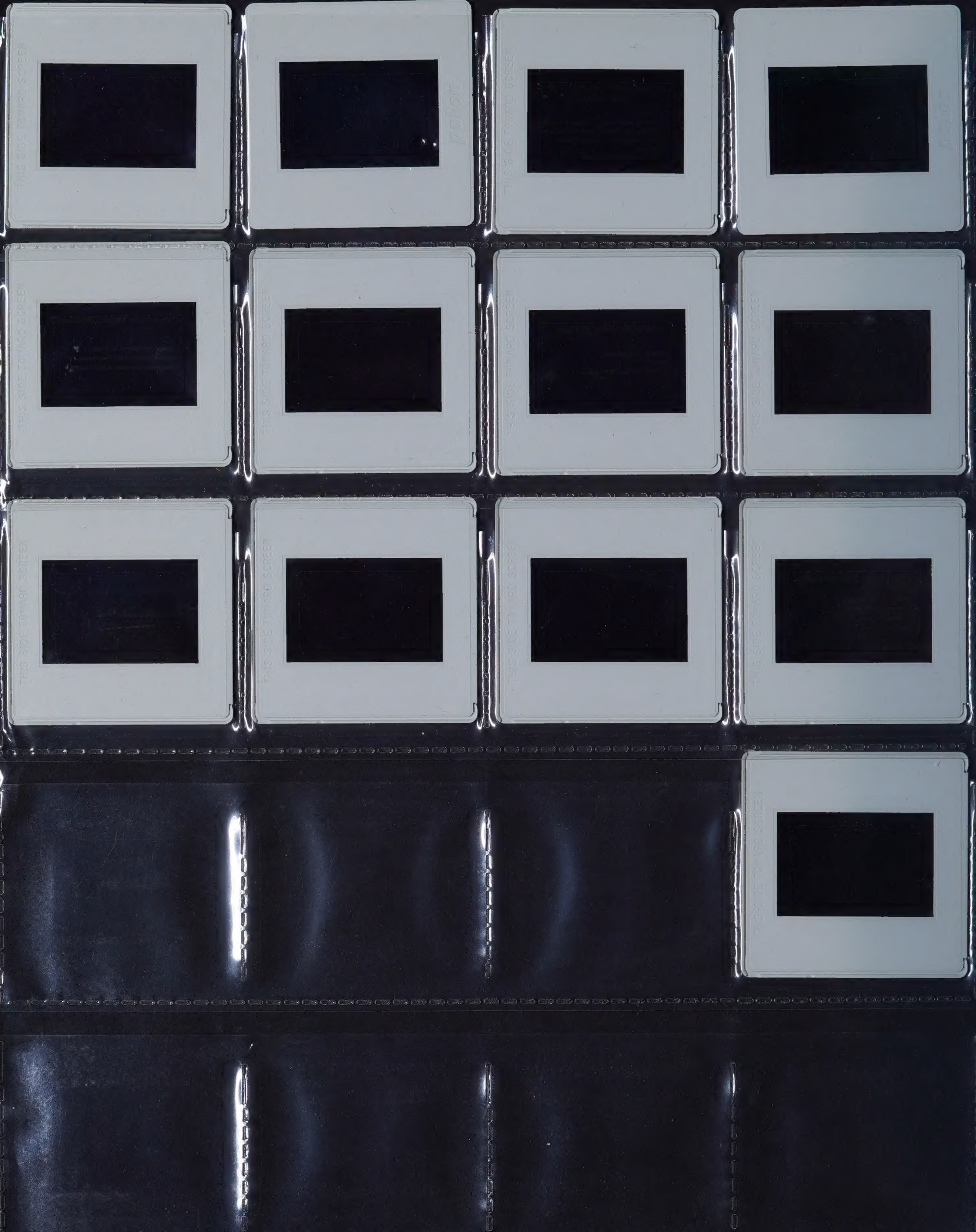
EPA, 1995. Letter from John Wardell, EPA to Jack Lynch, Butte-Silver Bow County (3/1/95).

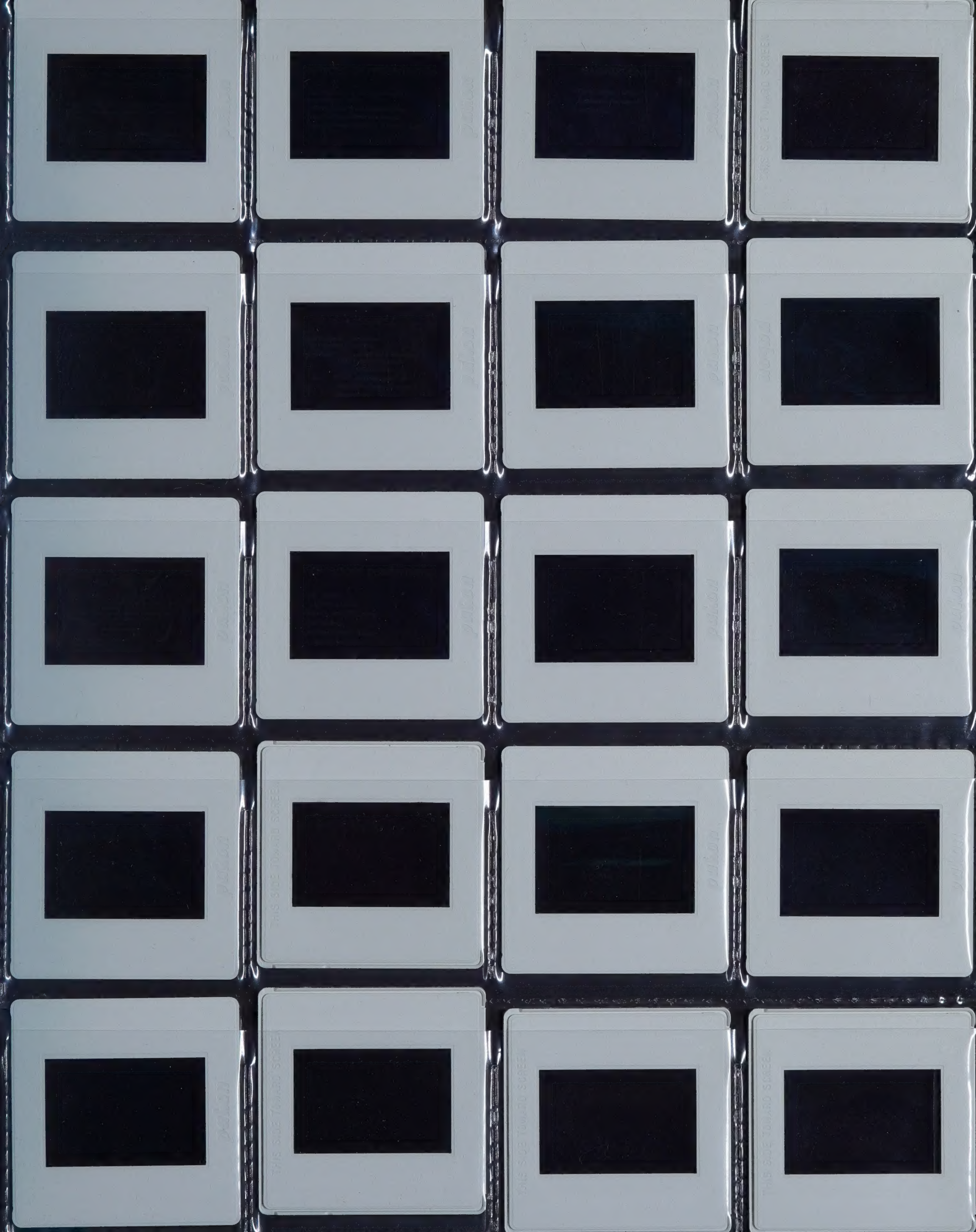
MDHES, 1995. Letter from Bob Robinson, MDHES, to Jack Lynch, Butte-Silver Bow County (3/23/95).

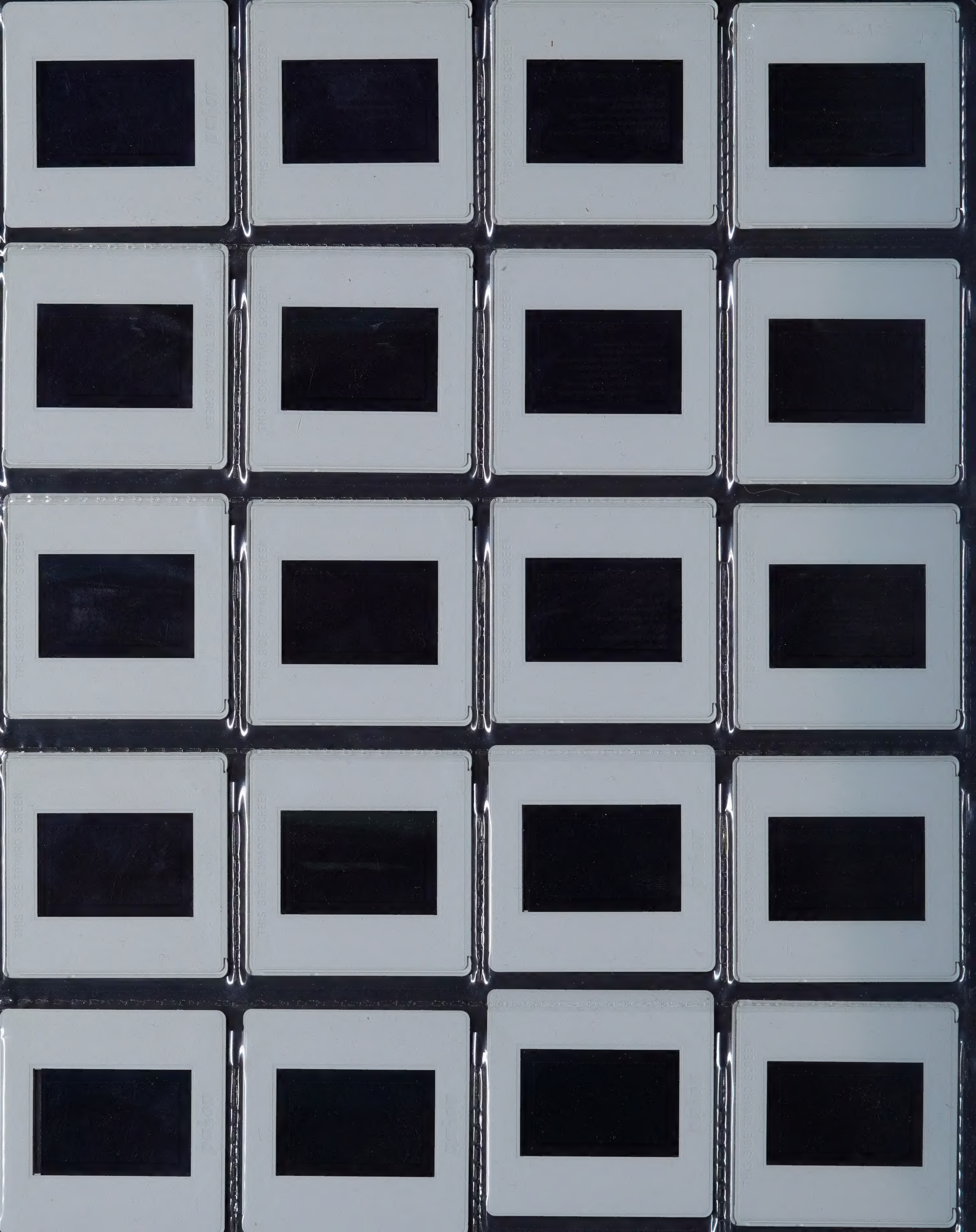
Pioneer, 1997. Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment (January, 1997, final addendum, February, 1997). Prepared by Pioneer Technical Services, Butte, MT.

Pioneer, 1999. August 23, 1999 letter from Shawn Bisch to Pat Crowley regarding semi-annual groundwater monitoring results. Data on file at Montana Department of Environmental Quality.




THIS SIDE TOWARD SCREEN
Pakon


pakon
THIS SIDE TOWARD SCREEN


THIS SIDE TOWARD SCREEN

ARCO
ARCO Environmental
Remediation, L.L.C

Old Butte L.F.
Closure

RECEIVED
FEB 11 1998
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

County Silver Bow
Facility & # Butte 20
Closure
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Other: Corrective Measures
Assessment Closure
4-3
Landfarm
Liner
Methane
O & M
Run - On

February 3, 1998

Bob Rowling
Director, Parks and Recreation
Butte-Silver Bow, Department of Public Works
Courthouse
220 West Granite Street
Butte, Montana 59701

Dear Mr. Rowling:

Attached are two copies of the preliminary design documents for the Clark Tailings Recreational Facility. A copy has also been sent directly to Jon Sesso. These documents summarize the preliminary design plans for construction of the facility, consistent with the design schedule, which we discussed during our kickoff meeting on November 20, 1997 and the concept review meeting on December 12, 1997. These documents are being provided for your review before our February 12, 1998 meeting.

The preliminary design reflects the base program that AERL intends to construct. The features included in the facility are those agreed to by Butte-Silver Bow and ARCO Environmental Remediation, L.L.C. last spring (see Jack Lynch's February 19, 1997 letter to Sandy Stash), with the following exceptions:

1. The amphitheater mentioned in the February 19 letter has been traded for a children's playground, as agreed to last spring;
2. The plan reflects a total of five ball fields, rather than the six mentioned in the letter. This was done as a result of our kickoff meeting, where you expressed a desire to remove one of the softball fields and use the money saved for other park amenities or for maintenance equipment.

At meetings and ensuing correspondence, you have requested AERL to include a number of other features, such as a covered grandstand and a batting cage, as part of the base program. The preliminary design documents do not include those additional amenities you requested. These features are not part of the base program agreed to last spring. We have received and reviewed your letters of December 23, 1997 and January 29, 1998, stating that you feel that more features should be considered part of the base program. However, the features included in this preliminary design meet the terms of our agreement. Because of your concerns that we will not construct a park as costly as that discussed last spring, we offered at our January 20, 1998 meeting to change the management approach of the project's design to a target budget rather than the base program agreed to last spring. This offer still stands; the bid package could be structured so that it includes a modest base program and a number of additive alternates, including many of those additional features you have expressed an interest in adding to the park. BSB could then pick and choose from the alternates list until the budget of $2.5 million is realized. If you would like us to proceed this way, it is necessary for us to know soon as we are making the transition to preparing construction documents for the project.

In preparing the preliminary design, we made some assumptions regarding services and features provided by BSB. These include the following.

1. AERL will terminate water and sanitary sewer utilities at the beginning of the entrance road to the park. BSB will extend the city utilities to this point.
2. The irrigation system for the park will utilize the pond on the south end of the site for an equalization station. An irrigation pump house will be constructed at this pond. Surface water runoff and an extension of the water main installed to serve the park will provide irrigation water. AERL will continue to explore other options for irrigation water, including a partnering agreement with BSB to construct an effluent discharge line from the wastewater treatment plant.
3. Existing fences at the site will be retained and shall become part of the exterior site fence.

We look forward to meeting with you on February 12 to discuss this submittal.

Sincerely,

Chuck Stilwell

Chuck Stilwell, P.E.
Project Manager

cc: Jon Sesso, BSB, w/attachment
Sandy Stash, AERL
Ron Ziegler, AERL
Brad Archibald, Pioneer Technical Services

bcc: M. Dianne Smith, AERL (w/out attachment)
Bill Duffy, PMH&S (w/out attachment)
Pat Crowley, MDEQ (w/attachment)

Map File

Closure
Old Butte L.F.

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FEB 11 1998
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Preliminary Design Report
Clark Tailings Recreation Facility

Butte - Silver Bow County, Montana
ARCO Environmetal Remediation, LLC.

Pioneer
EDAW
2-2-98

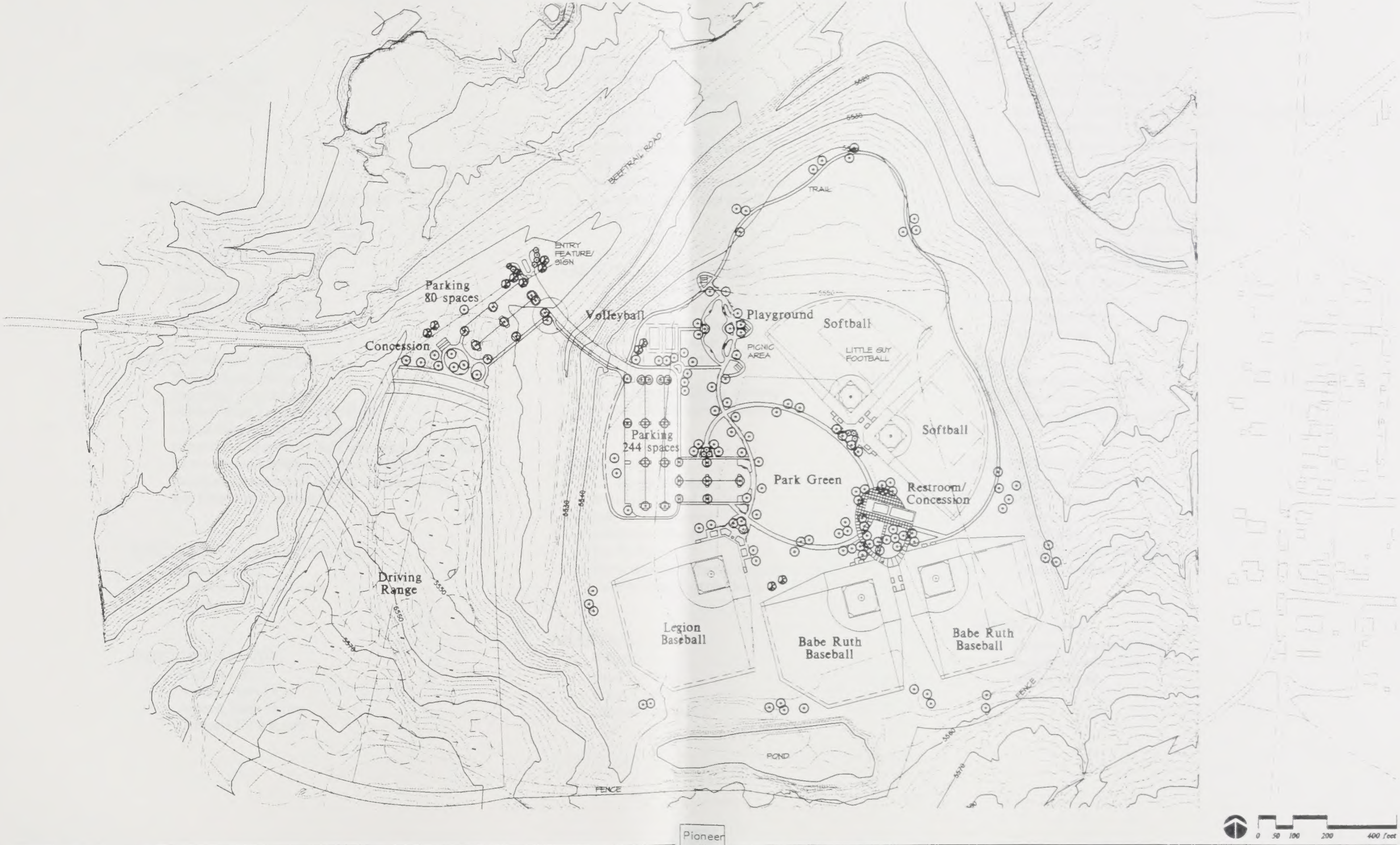
Table of Contents

Clark Tailings Recreational Facility

- Master Plan
- Park Program
- Sports Field Standards
- Thematic Development
- Architectural Plans
- Landscape Plan
- Irrigation Master Plan
- Utility Master Plan
- Electrical Master Plan
- Driving Range Equipment

Master Plan Concept

Clark Tailings Recreational Facility


ENTRY FEATURE/ SIGN
BEEFTRAIL ROAD
TRAIL
Parking 80 spaces
Concession
Volleyball
Playground
Softball
LITTLE GUY FOOTBALL
PICNIC AREA
Parking 244 spaces
Softball
Park Green
Restroom/ Concession
Driving Range
Legion Baseball
Babe Ruth Baseball
Babe Ruth Baseball
POND
FENCE
FENCE
5620
5550
5550
5530
5540
5550
5560
5570
5580
5570
0 50 100 200 400 feet

Pioneer
EDAW
2-2-98

ARCO ENVIRONMENTAL REMEDIATION, L.L.C.

Park Program

Clark Tailings Recreational Facility

UTILITIES

- Sanitary Sewer
- Water Service
- Storm Sewers

IRRIGATION

- Large Radius Spray - Ballfield Turf
- Large Radius Spray - Park Turf
- Small Radius Spray - Park Turf
- Small Radius - Shrub Beds
- Sleeving
- Control System
- Irrigation Holding Pond
- Irrigation Pump Station

SITE ELECTRICAL SYSTEM

- Parking Lot Lighting
- Pedestrian Area Lighting
- Softball Field Lighting (One Field)
- Legion Baseball Field Lighting
- Expansion Capacity for Ballfield Lighting (3 Fields)
- Picnic Shelter Lighting and Electrical Service
- Restroom/Concession Lighting and Electrical
- Site Electrical Distribution

PARK ROADS AND PARKING AREAS

- Asphalt Paving
- Concrete Curb and Gutter
- Striping

PEDESTRIAN PAVING

- Asphalt Path
- Asphalt Walkways
- Asphalt Plaza Paving
- Concrete Curb Ramp

LEGION BASEBALL FIELDS

- 40' Height Backstop
- 25' Height Wing Fencing
- 6' Height Outfield Fencing
- Infield Mix Mowstrip
- Infield Mix Warning Strip
- Bat Racks
- Metal Bleachers (150 to 300 total seats)
- Covered Dugouts with Bench
- Scoreboard

BABE RUTH BASEBALL FIELDS

- 25' Height Backstop
- 10' Height Wing Fencing
- 6' Height Outfield Fencing
- Infield Mix Mowstrip
- Infield Mix Warning Strip
- Bat Racks
- Metal Bleachers (2 sets, 3 rows)
- Covered Dugouts with Bench
- Scoreboards

SOFTBALL FIELDS

- 25' Height Backstop
- 6' Height Outfield Fencing
- Infield Mix Mowstrip
- Infield Mix Warning Strip
- Bat Racks
- Metal Bleachers (2 sets, 3 rows)
- Covered Dugouts with Bench

VOLLEYBALL COURTS

- Two Courts
- Sand Surfacing
- Court Curbing
- Net and Standards

ARCHITECTURE

- Legion Baseball Press Box
- Babe Ruth Press Box (One Field)
- Large Restroom/Changing Areas/Concession/Maintenance
- Picnic Shelters (3 Total, 15' x 15')
- Driving Range Concession Building

LANDSCAPE

- Imported Clean Fill
- Field Soil Prep
- Non-Irrigated Seed (Perimeter Areas)
- Irrigated Seed (Park Areas)
- Baseball/Softball Irrigated Seed
- Ornamental Trees
- Deciduous Trees
- Evergreen Trees
- Shrub Areas

SIGNAGE

- Identification Signage
- Regulatory Signage
- Accessible Parking Signage

SITE FURNISHINGS

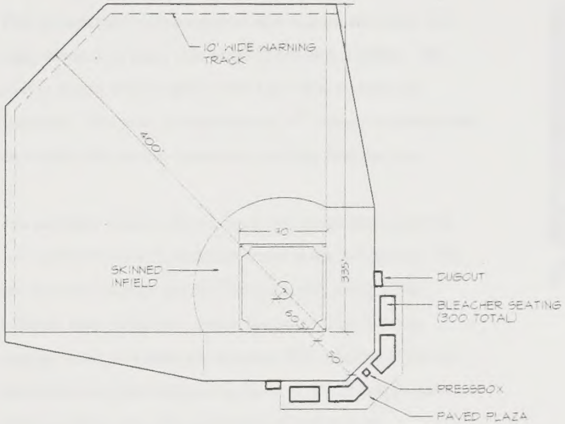
- Playground Equipment
- Picnic Tables
- Benches
- Bike Racks
- Trash Dumpster Enclosure
- Trash Containers

DRIVING RANGE

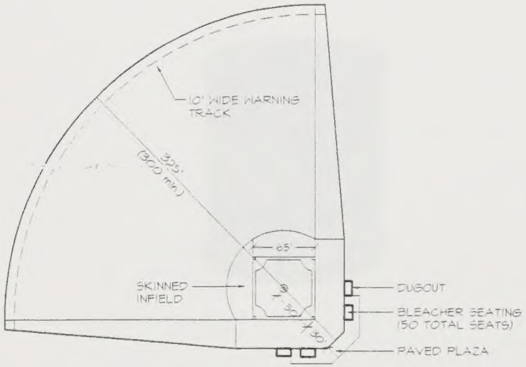
- Irrigation System at Tees
- Irrigated Seed at Tees
- Range Targets

Sports Field Standards

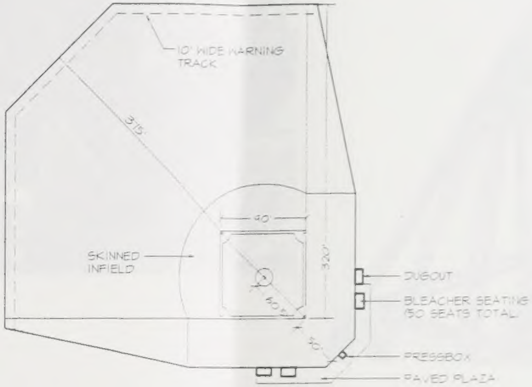
Clark Tailings Recreational Facility


10' WIDE WARNING TRACK
400'
90
335'
SKINNED INFIELD
60'
90'
DUGOUT
BLEACHER SEATING (300 TOTAL)
PRESSBOX
PAVED PLAZA

Legion Baseball

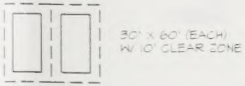

10' WIDE WARNING TRACK
325' (300 min)
65'
SKINNED INFIELD
50'
30'
DUGOUT
BLEACHER SEATING (50 TOTAL SEATS)
PAVED PLAZA

Softball

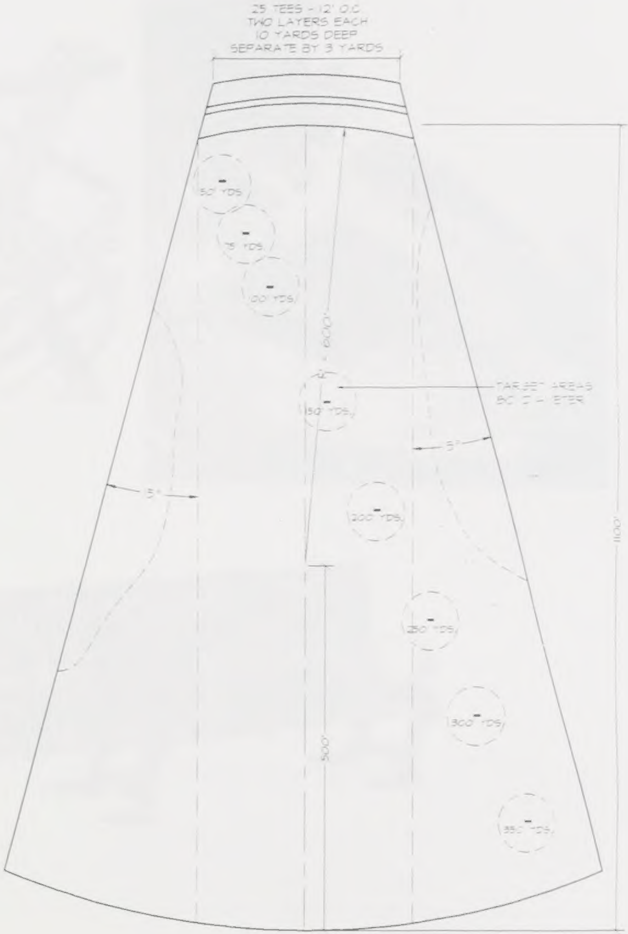

10' WIDE WARNING TRACK
315'
40
320'
SKINNED INFIELD
60'
30'
DUGOUT
BLEACHER SEATING (50 SEATS TOTAL)
PRESSBOX
PAVED PLAZA

Babe Ruth Baseball

Football


30' X 60' (EACH)
W/ 10' CLEAR ZONE

Volleyball


25 TEES - 12' O.C.
TWO LAYERS EACH
10 YARDS DEEP
SEPARATE BY 3 YARDS
50' YDS
75' YDS
100' YDS
600'
150' YDS
TARGET AREAS
50' DIAMETER
5°
5°
200' YDS
250' YDS
300' YDS
350' YDS
500'
1100'

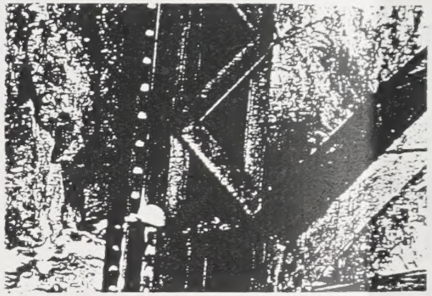
Driving Range

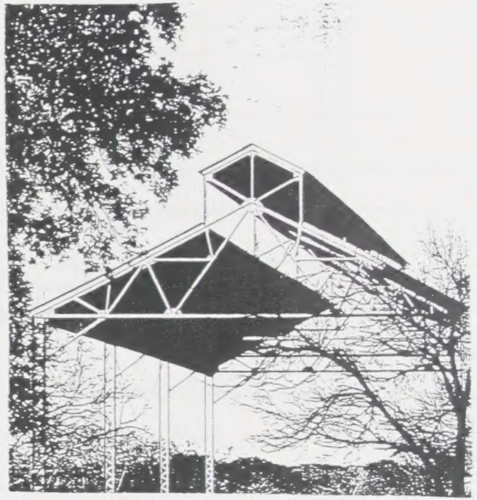
Thematic Development - Steel/Industrial Theme

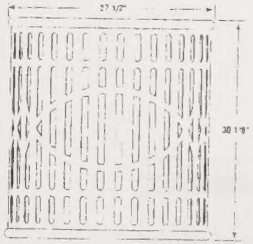
Clark Tailings Recreational Facility

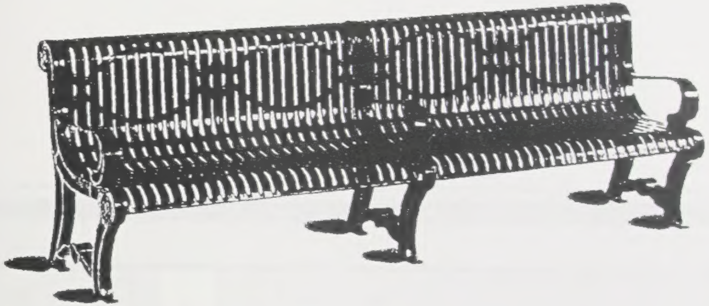
This architectural style consists of steel trusses and other 'raw' materials such as stone with simple forms and detailing. The style is simple and straightforward but rich in texture and materials. This style is reminiscent of 19th century structures that were built with natural vernacular materials from the area.

The materials found in the site work will be similar to the type, color and texture of the materials found in the architecture. The site amenities include benches, bicycle racks, picnic tables, bollards, trash containers, pedestrian and parking lighting, signage, walls, and other site elements. The detailing of the site amenities should be simplistic in detail, although rich in materials, reflecting the rustic utilitarian period of architecture.





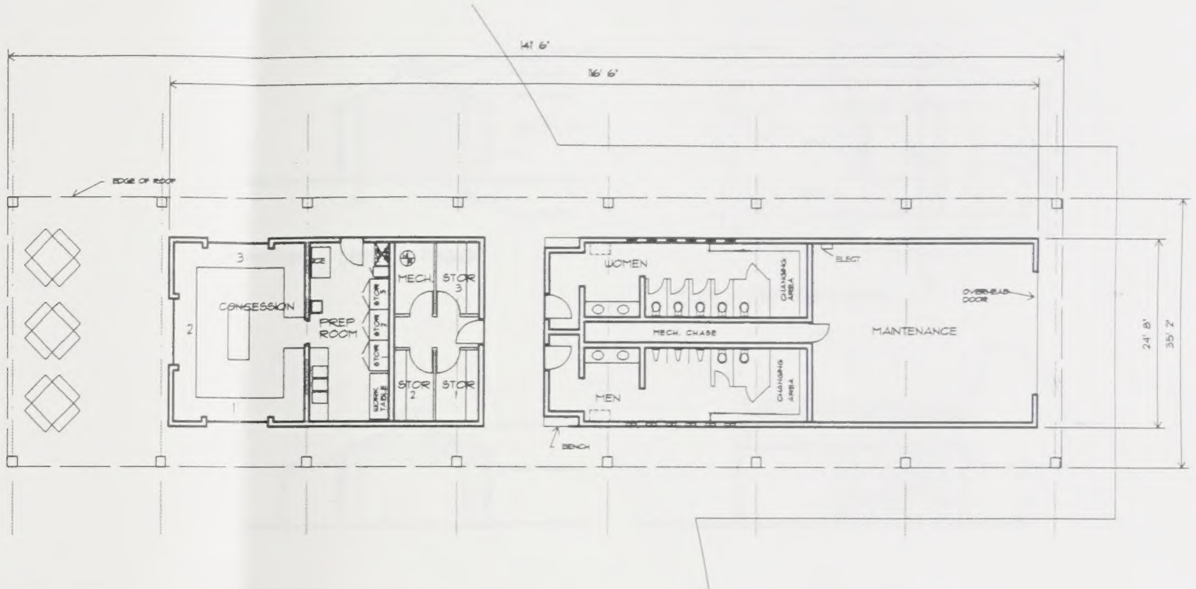




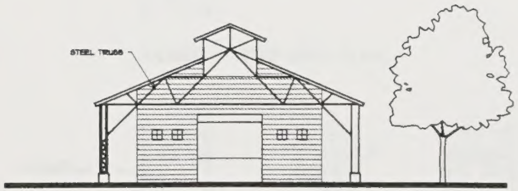
Concession / Restroom Building

Clark Tailings Recreational Facility

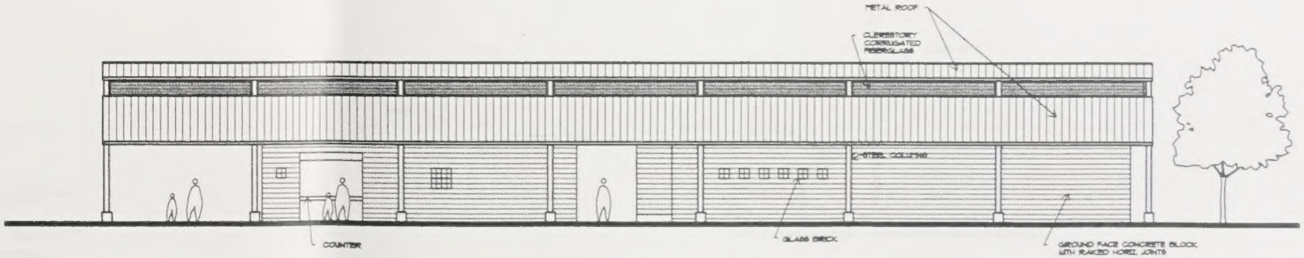
2676 SQUARE FEET ENCLOSED BUILDING
4976 SQUARE FEET ROOFED AREA
2300 SQUARE FEET OPEN COVERED AREA


141' 6"
116' 6"
EDGE OF ROOF
3
2
1
CONCESSION
ICE
PREP ROOM
STOR 3
STOR 2
STOR 1
WORK TABLE
MECH.
STOR 3
STOR 2
STOR 1
WOMEN
MEN
CHANGING AREA
CHANGING AREA
MECH. CHASE
ELECT
BENCH
MAINTENANCE
OVERHEAD DOOR
24' 8"
35' 2"

PLAN


STEEL TRUSS

WEST ELEVATION


METAL ROOF
CLERESTORY CORRUGATED FIBERGLASS
STEEL COLUMNS
COUNTER
GLASS BRICK
GROUND FACE CONCRETE BLOCK WITH RAKED HORIZ. JOINTS

SOUTH ELEVATION

The ARCHITECTS' STUDIO

Pioneer
○
EDAW
2 - 2 - 98

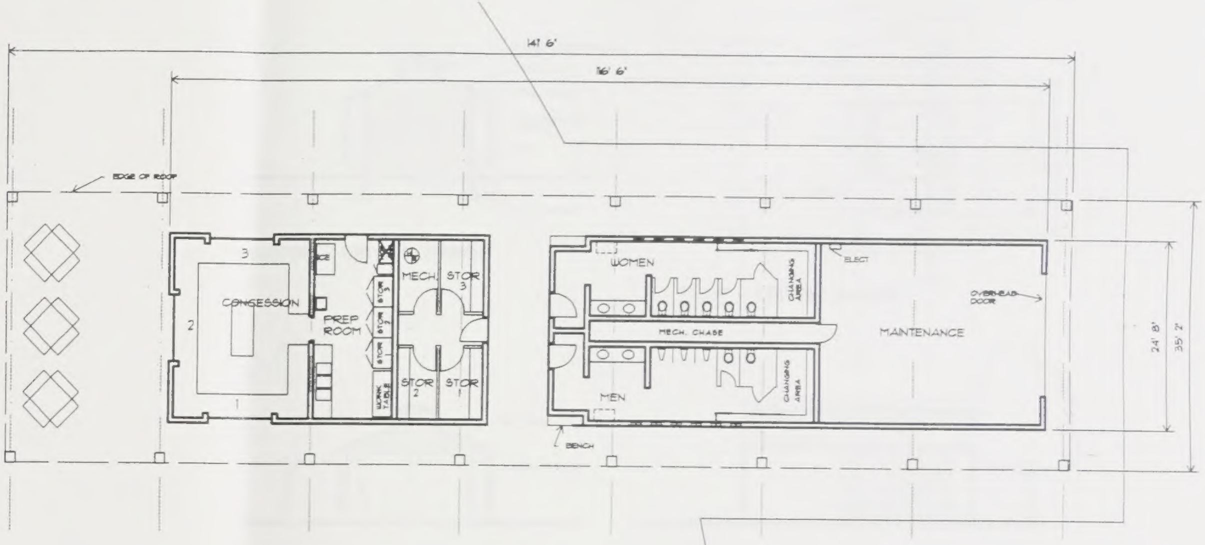
0
4
8
16
24 feet

ARCO ENVIRONMENTAL REMEDIATION, L.L.C.

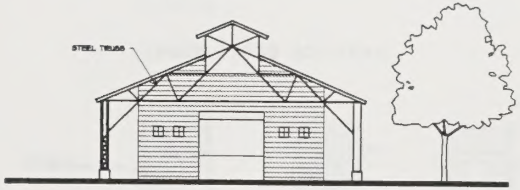
Concession / Restroom Building

Clark Tailings Recreational Facility

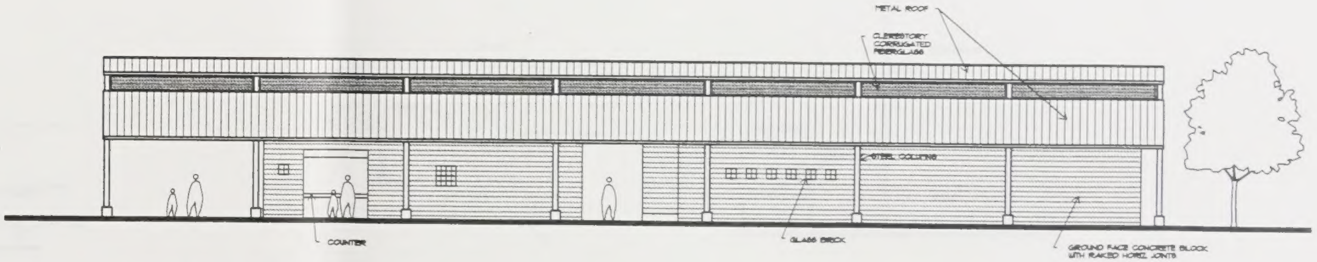
2676 SQUARE FEET ENCLOSED BUILDING
4976 SQUARE FEET ROOFED AREA
2300 SQUARE FEET OPEN COVERED AREA


141' 6'
116' 6'
EDGE OF ROOF
3
2
1
CONCESSION
ICE
PREP ROOM
STOR 3
STOR 2
STOR 1
WORK TABLE
MECH
STOR 3
STOR 2
STOR 1
WOMEN
CHANGING AREA
MECH. CHASE
MEN
CHANGING AREA
ELECT
OVERHEAD DOOR
MAINTENANCE
BENCH
24' 8'
35' 2'

PLAN


STEEL TRUSS

WEST ELEVATION


METAL ROOF
CLERESTORY CORRUGATED FIBERGLASS
STEEL COLUMNS
COUNTER
GLASS BRICK
GROUND FACE CONCRETE BLOCK WITH RAKED HORIZ. JOINTS

SOUTH ELEVATION

The ARCHITECTS' STUDIO

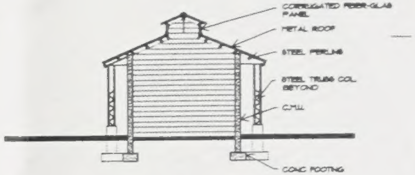
Pioneer
○
EDAW
2 - 2 - 96

0
4
8
16
24 feet

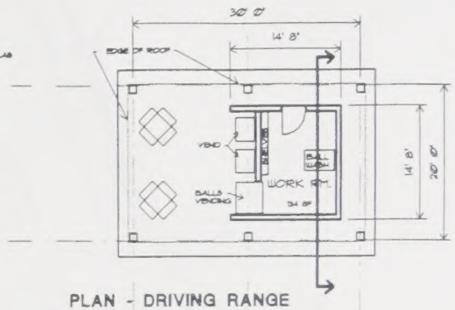
ARCO ENVIRONMENTAL REMEDIATION, L.L.C.

Park Buildings

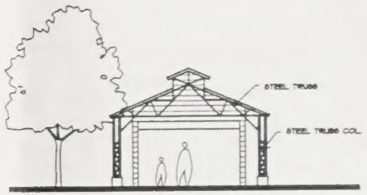
Clark Tailings Recreational Facility


CORRUGATED FIBER-GLAS PANEL
METAL ROOF
STEEL PERLINS
STEEL TRUSS COL. BEYOND
C.M.U.
CONC FOOTING

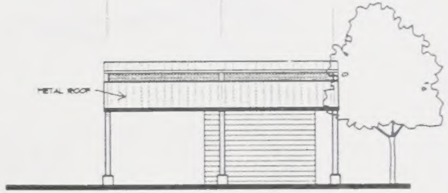
SECTION - DRIVING RANGE


30' 0"
14' 8"
EDGE OF ROOF
VEND
BALLS VENDING
BALL WASH
WORK RM.
14' 8"
20' 0"

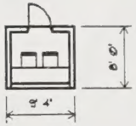
PLAN - DRIVING RANGE


STEEL TRUSS
STEEL TRUSS COL.

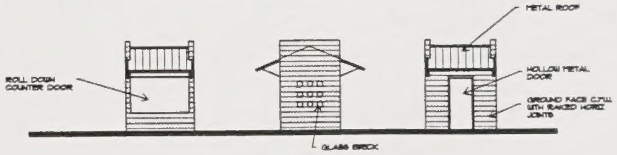
ELEVATION - DRIVING RANGE



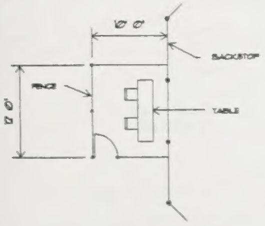
ELEVATION - DRIVING RANGE



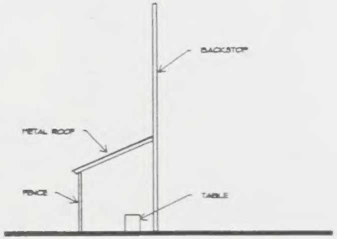
LEGION PRESS BOX PLAN


METAL ROOF
ROLL DOWN COUNTER DOOR
HOLLOW METAL DOOR
GROUND FACE C.M.U. WITH RAKED HORIZ JOINTS
GLASS BRICK

LEGION PRESS BOX ELEVATIONS


10' 0"
BACKSTOP
FENCE
TABLE
12' 0"

BASEBALL PRESS BOX PLAN


BACKSTOP
METAL ROOF
FENCE
TABLE

BASEBALL PRESS BOX SECTION

The ARCHITECTS' STUDIO

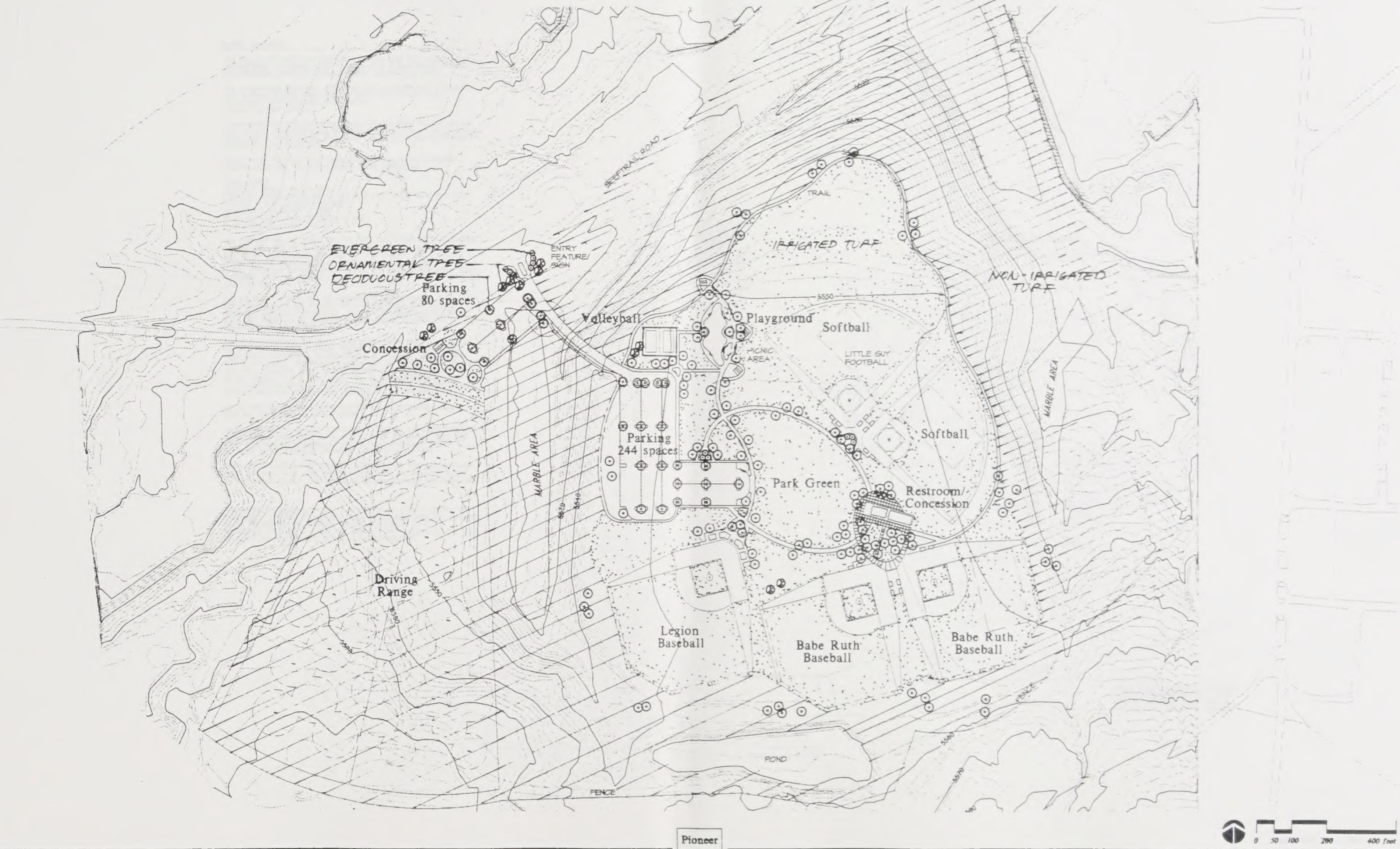
Pioneer
○
EDAW
2 - 2 - 94

0 4 8 16 24 feet

ARCO ENVIRONMENTAL REMEDIATION, L.L.C.

Landscape Plan Concept

Clark Tailings Recreational Facility


EVERGREEN TREE
ORNAMENTAL TREE
DECIDUOUS TREE
ENTRY FEATURE/ SIGN
Parking 80 spaces
Concession
Volleyball
BELTRAIL ROAD
TRAIL
IRRIGATED TURF
NON-IRRIGATED TURF
5550
Playground
PICNIC AREA
Softball
LITTLE GUY FOOTBALL
Softball
MARBLE AREA
Parking 244 spaces
MARBLE AREA
Park Green
Restroom/ Concession
Driving Range
Legion Baseball
Babe Ruth Baseball
Babe Ruth Baseball
POND
FENCE
FENCE
0 50 100 200 400 foot

Irrigation Master Plan

Clark Tailings Recreational Facility

DESIGN APPROACH

THE GOAL IS TO DESIGN AN IRRIGATION SYSTEM THAT WILL MAINTAIN AESTHETICALLY PLEASING PLANT MATERIAL WITH A REASONABLE INITIAL CONSTRUCTION COST AND MINIMAL ANNUAL MAINTENANCE COSTS.

THE ANTICIPATED IRRIGATION SYSTEM WILL BE A COMBINATION SPRINKLER AND BUBBLER SYSTEM USING POP-UP ROTOR OR POP-UP SPRAY SPRINKLERS, AND BUBBLERS TO TREES AND SMALL PLANTER AREAS.

PLANT MATERIALS WITH DIFFERENT WATER REQUIREMENTS WILL BE VALVED SEPARATELY. SPRINKLERS WILL BE GROUPED INTO LATERALS ZONES BASED UPON SIMILAR PRECIPITATION RATES AND EXPOSURE TO ALLOW MAXIMUM FLEXIBILITY AND EFFICIENCY.

BASED UPON THE FOLLOWING ASSUMPTIONS, THE FLOW AND PRESSURE REQUIREMENTS FOR THE WATER SUPPLY WERE DETERMINED.

ASSUMPTIONS:
IRRIGATED AREA - 28.0 ACRES
IRRIGATION OPERATION WINDOW - 8 HOURS PER DAY, 6 DAYS PER WEEK
PEAK ET - 1.75 INCHES PER WEEK
APPLICATION EFFICIENCY - 70%
PUMP/TAP UTILIZATION EFFICIENCY - 90%
FLOW REQUIRED - 706 GPM

THE MAINLINE WILL BE CLASS 200 PVC PIPE, THE SPRINKLER AND BUBBLER LATERAL PIPE WILL BE CLASS 200 PVC. SPECIFIED PIPE BURIAL DEPTHS WILL BE 18" FOR MAINLINE PIPE AND 12" FOR LATERAL PIPE. CONTROL WIRING WILL BE ADJACENT TO OR BELOW MAINLINE BURIAL DEPTHS. WHERE IRRIGATION MAINLINE AND CONTROL WIRE MUST CROSS UNDER HARD SURFACES, PIPE AND WIRE WILL BE ROUTED THROUGH SEPARATE PVC CLASS 200 SLEEVES.

THE IRRIGATION SYSTEM WILL BE DESIGNED TO BE WINTERIZED AS NEEDED USING COMPRESSED AIR INJECTED AT A WINTERIZATION POINT LOCATED NEAR THE POINT-OF-CONNECTION. GATE VALVES WILL PROVIDE FOR LOCALIZED ISOLATION OF SECTIONS OF THE SYSTEM TO ASSIST IN WINTERIZATION AND MAINTENANCE.

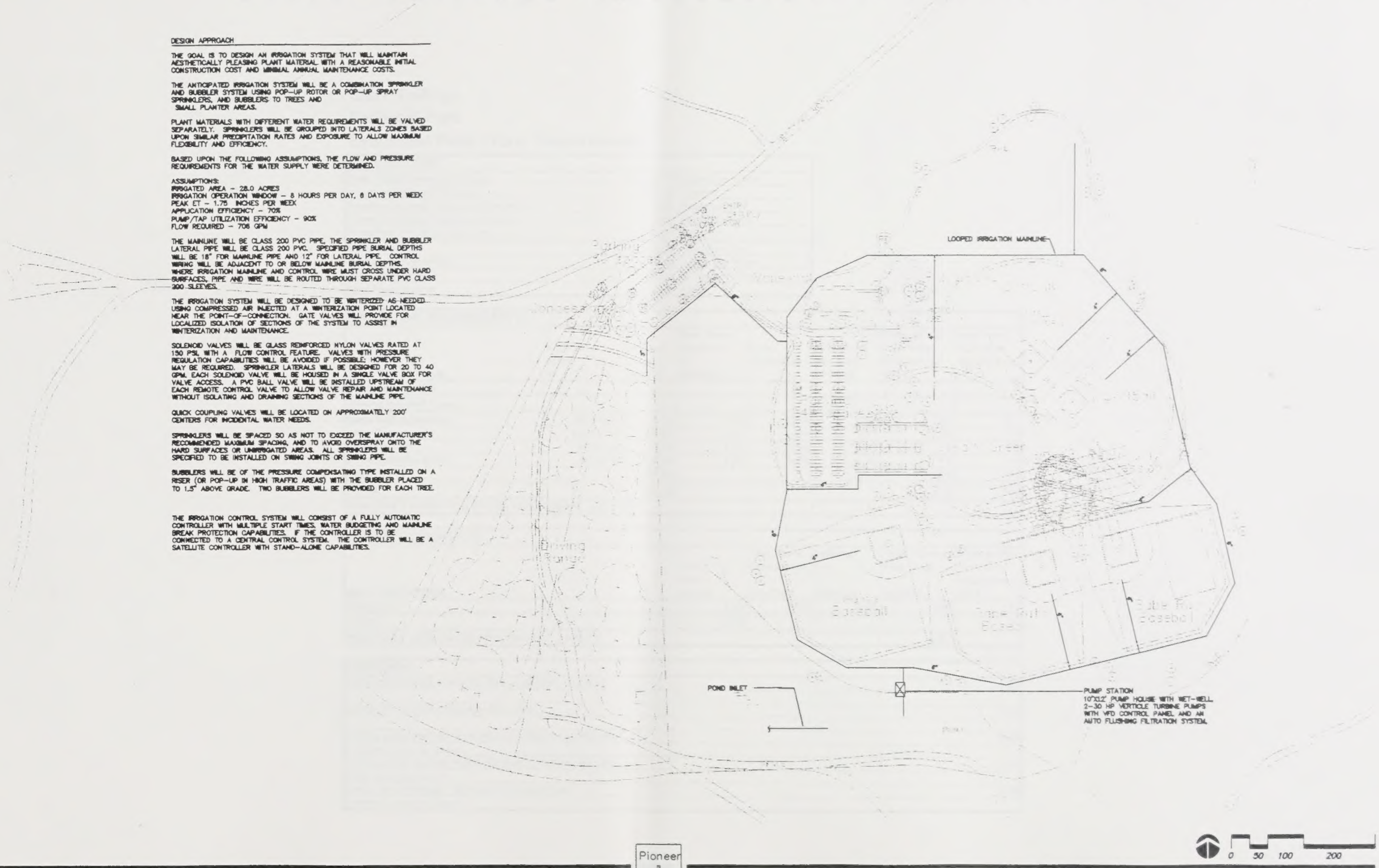
SOLENOID VALVES WILL BE GLASS REINFORCED NYLON VALVES RATED AT 150 PSI, WITH A FLOW CONTROL FEATURE. VALVES WITH PRESSURE REGULATION CAPABILITIES WILL BE AVOIDED IF POSSIBLE; HOWEVER THEY MAY BE REQUIRED. SPRINKLER LATERALS WILL BE DESIGNED FOR 20 TO 40 GPM. EACH SOLENOID VALVE WILL BE HOUSED IN A SINGLE VALVE BOX FOR VALVE ACCESS. A PVC BALL VALVE WILL BE INSTALLED UPSTREAM OF EACH REMOTE CONTROL VALVE TO ALLOW VALVE REPAIR AND MAINTENANCE WITHOUT ISOLATING AND DRAINING SECTIONS OF THE MAINLINE PIPE.

QUICK COUPLING VALVES WILL BE LOCATED ON APPROXIMATELY 200' CENTERS FOR INCIDENTAL WATER NEEDS.

SPRINKLERS WILL BE SPACED SO AS NOT TO EXCEED THE MANUFACTURER'S RECOMMENDED MAXIMUM SPACING, AND TO AVOID OVERSPRAY ONTO THE HARD SURFACES OR UNIRRIGATED AREAS. ALL SPRINKLERS WILL BE SPECIFIED TO BE INSTALLED ON SWING JOINTS OR SWING PIPE.

BUBBLERS WILL BE OF THE PRESSURE COMPENSATING TYPE INSTALLED ON A RISER (OR POP-UP IN HIGH TRAFFIC AREAS) WITH THE BUBBLER PLACED TO 1.5" ABOVE GRADE. TWO BUBBLERS WILL BE PROVIDED FOR EACH TREE.

THE IRRIGATION CONTROL SYSTEM WILL CONSIST OF A FULLY AUTOMATIC CONTROLLER WITH MULTIPLE START TIMES, WATER BUDGETING AND MAINLINE BREAK PROTECTION CAPABILITIES. IF THE CONTROLLER IS TO BE CONNECTED TO A CENTRAL CONTROL SYSTEM. THE CONTROLLER WILL BE A SATELLITE CONTROLLER WITH STAND-ALONE CAPABILITIES.



PUMP STATION
10'X12' PUMP HOUSE WITH WET-WELL
2-30 HP VERTICLE TURBINE PUMPS
WITH VFD CONTROL PANEL AND AN
AUTO FLUSHING FILTRATION SYSTEM

Clark Tailings
Regional Park
Estimated Peak Water Requirements

ASSUMPTIONS		
Peak Week Evapotraspiration:	1.75	Inches per Week
Irrigation System Efficiency:	70.00	Percent
Irrigation System Operation Window	8.00	Hours per day
Weekly Irrigation System Operation	6.00	Days Per Week
Pump/Tap Utilization Efficiency	90.00	Percent
Make up Water	24.00	Hours per Day
Peak Lake Evaporation	2.20	Inches per Week
Lake Seepage Rate	0.00	Inches per Week
Lake Surface Area	2.40	Acres

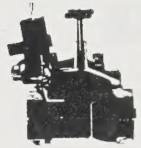
IRRIGATION REQUIREMENTS

AREA DESCRIPTION	Irrigated Area SF	Irrigated Area ACRES	Peak Week Reference ET IN/WEEK	Crop Coefficient	Peak Week Irrig. Req. IN/WEEK	Make up H2o Peak Flow Requirement GPM	Irrig. Pump Peak Flow Requirement
PARK IRRIGATION							
Existing Irrigated Areas							
Large Radius Ballfields	451360.00	10.36	1.75	1.00	1.75	81	271
Large Radius (turf)	690017.00	15.84	1.75	1.00	1.75	124	415
Small Radius	60000.00	1.38	1.75	0.65	1.40	9	29
Medium Radius (tees)	20000.00	0.46	1.75	1.65	1.75	4	12
Subtotals		28.04				206	686
TOTAL		28.04				212	706
PEAK DAILY IRRIGATION WATER REQUIREMENT, ACRE FT.					0.94		

LAKE REQUIREMENTS

AREA DESCRIPTION			Lake Area ACRES	Peak Week Evaporation IN/WEEK	Seepage Loss IN/WEEK	Total Losses Peak Week IN/WEEK	Makeup H2O Peak Flow Requirement GPM
Onsite Pond			2.40	2.20	0.00	2.20	17
TOTAL			2.40				17
PEAK DAILY LAKE WATER REQUIREMENT, ACRE FT.						0.07	

SUMMARY	
TOTAL PEAK DAILY WATER REQUIREMENT, ACRE FT.	1.01
MAKE UP WATER REQUIREMENT, GPM	228
TOTAL LAKE WATER SURFACE FLUCTUATION, INCHES (without make-up water)	5.05
TOTAL LAKE WATER SURFACE FLUCTUATION, INCHES (with make-up water)	3.37
DAYS OF STORAGE, 12" MAX FLUCTUATION (without make-up water)	2.38



Electric Remote-Control Valves

EFB-CP SERIES

1", 1¼", 1½", 2" (26/34, 33/42, 40/49, 50/60)

Primary Application

Powerful brass dirty water valve with a contamination-proof, self-flushing screen that cleans itself and resists debris build-up.

Features

- Red brass body and bonnet for long life and rugged performance at 200 psi pressure.
- Contamination-proof, self-flushing nylon screen resists debris build-up. Water flow consistently flushes the screen, dislodging particles and debris before they can accumulate and clog the filter.
- Reverse flow feature ensures valves fail in the closed position if the diaphragm tears or rips. Prevents flooding, water waste and landscape damage. Exceptional feature for master valves or valves used in slope areas.
- Fluid resistor slows water flow through the solenoid, reducing closing speed and preventing system damage caused by water hammer.
- One-piece solenoid design with captured plunger and spring for easy servicing. Prevents loss of parts during field service.
- Manual internal and external bleed. External bleed does not allow debris to go through the solenoid ports when system is flushed. Internal bleed manually operates the valve without leaking into the valve box: allows pressure regulator to be adjusted without turning the valve on at the controller first.
- Solenoid low power requirement allows for longer wire runs without increased wire gauge size. Ideal for median strips, highways and other lengthy installations.
- Flow control handle adjusts water flow as needed.
- Accommodates optional, field installed PRS-B pressure regulating module to ensure maximum sprinkler performance.
- Accepts latching solenoid for use with Rain Bird battery-operated controllers.

150-EFP-CP

150-EFB-CP-PRS-8

Operating Range

- Pressure: 15 to 200 psi (1 to 14 Bars)
- Flow without PRS-B option: 5 to 200 GPM (1 to 46 m³/h; 0.56 to 12,78 l/s)
- Flow with PRS-B option: 10 to 200 GPM (2 to 46 m³/h; 0.63 to 12,78 l/s)
- Temperature: up to 150° F (66° C)

Electrical Specifications

- 24 VAC 50/60 cycle solenoid power requirement: 0.41 A (9.9 VA) inrush current: 0.23 A (5.5 VA) holding current

Dimensions

- 100-EFB-CP: Height: 6" (15.2 cm) Length: 4½" (11,4 cm) Width: 3¼" (8.3 cm)
- 125-EFB-CP: Height: 5¾" (14.6 cm) Length: 5" (12,7 cm) Width: 3¼" (8.3 cm)
- 150-EFB-CP: Height: 6½" (16.5 cm) Length: 5½" (14 cm) Width: 4½" (11,4 cm)
- 200-EFB-CP: Height: 7" (17.8 cm) Length: 6¾" (17,1 cm) Width: 5¾" (14.6 cm)

Note: The PRS-B option adds 2" to the valve height.

Models

- 100-EFB-CP: 1" (26/34)
- 125-EFB-CP: 1¼" (33/42)
- 150-EFB-CP: 1½" (40/49)
- 200-EFB-CP: 2" (50/60)
- 100-EFB-CP-BSP: 1" (26/34), BSP threaded
- 150-EFB-CP-BSP: 1½" (40/49), BSP threaded
- 200-EFB-CP-BSP: 2" (50/60), BSP threaded

Note: Valve and PRS-B module must be ordered separately.

EFB-CP Series

Valve Pressure Loss (psi)*

Flow GPM	100 EFB-CP 1"	125 EFB-CP 1¼"	150 EFB-CP 1½"	200 EFB-CP 2"
5	3.0	-	-	-
10	3.3	-	-	-
15	4.0	-	-	-
20	5.0	5.0	2.7	1.5
30	9.0	6.0	2.9	1.6
40	13.0	8.0	3.2	1.8
50	20.0	10.0	3.7	2.0
60	-	13.0	4.5	2.3
80	-	20.0	8.0	3.1
100	-	-	12.9	4.4
120	-	-	18.1	6.2
140	-	-	24.0	8.5
160	-	-	-	11.0
180	-	-	-	14.0
200	-	-	-	16.8

EFB-CP Series METRIC

Valve Pressure Loss (Bars)*

Flow m³/h	Flow l/s	100 EFB-CP 1"	125 EFB-CP 1¼"	150 EFB-CP 1½"	200 EFB-CP 2"
1	0.26	-	-	-	-
2	0,55	0.24	-	-	-
3	0,83	0.26	-	-	-
4	1.11	0.31	-	-	-
5	1.39	0.37	0.36	0.19	0.11
6	1.67	0.50	0.40	0.20	0.11
7	1.94	0.63	0.44	0.20	0.11
8	2.22	0.76	0.48	0.21	0.12
9	2.50	0.92	0.53	0.21	0.12
10	2.78	1,09	0.60	0.23	0.13
12	3.33	-	0.75	0.26	0.15
14	3.89	-	0.88	0.33	0.16
16	4,44	-	1.14	0.43	0.19
22	6.11	-	-	0.82	0.30
28	7.78	-	-	1.31	0.46
34	9,44	-	-	-	0.66
40	11.11	-	-	-	0.91
46	12.78	-	-	-	1.16

* Loss values are with flow control fully open.

1) Rain Bird recommends flow rates in the supply line not to exceed 5 to 7.5 ft/sec. (2.3 m/s) in order to reduce the effects of water hammer.
2) For flows below 5 GPM (1 m³/h; 32 l/s) Rain Bird recommends use of upstream filtration to prevent debris from collecting below the diaphragm.
3) For flows below 10 GPM (2 m³/h; 63 l/s) Rain Bird recommends the flow control stem be turned down two full turns from the fully open position.

Note: PRS-B module is recommended for use only at flow rates in areas below solid line.

How to Specify:

100 - EFB-CP - PRS-B

Size	Model	Optional Feature
1" (26/34)	EFB-CP	PRS-B

Note: For non-US applications it is necessary to specify NPT or BSP thread type.

Quick-Coupling Valves

QUICK-COUPLING VALVES

Primary Application

Industrial-strength brass quick-coupling valves for water access.

Features

- Red brass body and bonnet for long life and rugged performance.
- Yellow thermoplastic cover for durability. Optional locking rubber cover on models 33DLRC, 44LRC, and 5LRC (use 2049 key to unlock). Metal cover on model 7 only.
- One-piece body design (models 3RC, 5RC, and 7).
- Two-piece body design for easy servicing (models 33DRC, 44LRC, and 44RC).
- Strong corrosion-resistant stainless steel spring prevents leakage.

Operating Range

- Flow: 10 to 125 GPM (3 to 28 m³/h; 0.83 to 7.78 l/s)
- Pressure: 5 to 125 psi (0.3 to 8.5 Bars)

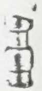
Dimensions

- 3RC Height: 4¼" (10.8 cm)
- 33DR Height: 4⅜" (11,1 cm)
- 33DLRC Height: 4⅝" (11,8 cm)
- 44RC Height: 6" (15.2 cm)
- 44LRC Height: 6" (15.2 cm)
- 5RC Height: 5½" (14 cm)
- 5LRC Height: 5½" (14 cm)
- 7 Height: 5¾" (14.6 cm)

Models

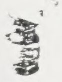
- 3RC: ¾" (20/27) Rubber Cover, 1-Piece Body
- 33DRC: ¾" (20/27) Double Track Key Lug, Rubber Cover, 2-Piece Body
- 33DLRC: ¾" (20/27) Double Track Key Lug, Locking Rubber Cover, 2-Piece Body
- 44RC: 1" (26/34) Rubber Cover, 2-Piece Body
- 44LRC: 1" (26/34) Locking Rubber Cover, 2-Piece Body
- 5RC: 1" (26/34) Rubber Cover, 1-Piece Body
- 5LRC: 1" (26/34) Locking Rubber Cover, 1-Piece Body
- 7: 1½" (40/49) Metal Cover, 1-Piece Body
- 5RC-BSP: 1" (26/34) Rubber Cover, 1-Piece Body, BSP threaded
- 5LRC-BSP: 1" (26/34) Locking Rubber Cover, 1-Piece Body, BSP threaded

Note: For non-US applications it is necessary to specify NPT or BSP thread type.



33 RC

33 DRC



33 DLRC

7

33-ONP

NON-POTABLE QUICK COUPLING VALVES

Primary Application

Industrial-strength brass quick-coupling valves for water access in non-potable systems.

Features

- Red brass body and bonnet for long life and rugged performance.
- Locking purple thermoplastic covers to restrict tampering (use 2049 key to unlock).
- Covers marked with **"Do Not Drink!"** warnings in English and Spanish to prevent ingestion.
- Two-piece body design for easy servicing.
- Strong corrosion-resistant stainless steel spring prevents leakage.

Operating Range

- Pressure: 5 to 125 psi (0.3 to 8.5 Bars)
- Flow: 10 to 70 GPM (3 to 15,96 m³/h; 0.63 to 4,42 l/s)

Dimensions

- 33DNP Height: 4⅝" (11,8 cm)
- 44NP Height: 6" (15,2 cm)

Models

- 33DNP: ¾" (20/27)
- 44NP: 1" (26/34)

Quick-Coupling Valves

Valve Pressure Loss (psi)

Flow GPM	3RC ¾"	33DRC/ 33DNP ¾"	44RC/ 44NP 1"	5RC 1"	7 1½"
10	1.3	2.0	-	-	-
15	4.7	4.5	2.2	-	-
20	7.2	7.6	4.4	-	-
30	-	-	11.5	1.9	-
40	-	-	-	3.8	-
50	-	-	-	6.4	1.7
60	-	-	-	9.6	2.5
70	-	-	-	14.0	3.6
80	-	-	-	-	4.9
100	-	-	-	-	8.4
125	-	-	-	-	14.0

Quick-Coupling Valves METRIC

Valve Pressure Loss (Bars)

Flow m³/h	Flow l/s	3RC ¾"	33DRC/ 33DNP ¾"	44RC/ 44NP 1"	5RC 1"	7 1½"
3	0,83	0.25	0.23	-	-	-
4	1,11	0,42	0.41	0.22	-	-
5	1.39	-	-	0.37	-	-
6	1.67	-	-	0.57	-	-
7	1.94	-	-	0.84	0.14	-
8	2.22	-	-	-	0.19	-
9	2.50	-	-	-	0.25	-
10	2.78	-	-	-	0.33	-
12	3.33	-	-	-	0.50	0.13
14	3.89	-	-	-	0.72	0.18
16	4.44	-	-	-	0.97	0.25
22	6.11	-	-	-	-	0.72
28	7.78	-	-	-	-	0.97

Adjustable Full-Circle Bubbler

1300A-F

Primary Application

Designed for tree, shrub and flower areas.

Features

- Fully adjustable flow.
- Shipped with SR-050 ½" (15/21) inlet filter screen for easy installation and resistance to debris.
- Operates over a wide range of pressures.
- Non-corrosive plastic and stainless steel construction for long life.

Operating Range

- Flow: 1.0 to 2.3 GPM (0,23 to 0,52 m³/h; 0,06 to 0,14 l/s)
- Spacing: 1 to 3 feet (0,3 to 0,9 m)
- Pressure: 10 to 60 psi (0,7 to 4 Bars)

Dimensions

- ½" (15/21) female threaded inlet
- Height: 1" (2,5 cm)
- Top diameter: 1" (2,5 cm)

Model

- 1300A-F

1300A-F

	psi	GPM
F ●	10	1.0
	20	1.4
	30	1.7
	40	1.9
	50	2.1
	60	2.3

1300A-F METRIC

	Bars	m³/h	l/s
F ●	0,75	0,23	0,07
	1	0,27	0,08
	1,5	0,33	0,09
	2	0,38	0,10
	2,5	0,42	0,12
	3	0,45	0,13
	3,5	0,48	0,13
	4	0,51	0,14

1400 Series

1300A-F

Pressure Compensating Full-Circle Bubblers

1400 SERIES

Primary Application

Irrigate tree, shrub and flower areas where pressure compensation is required.

Features

- Low flow rates allow water to be absorbed as needed. Reduce runoff.
- Flow will not fluctuate at pressures between 20 and 90 psi. Maintains even flow.
- Flow is not adjustable for increased vandal resistance.
- No adjustment required.
- Corrosion-proof plastic and rubber construction for long life.
- Five-year trade warranty.*
- Shipped with special SR-050 ½" (15/21) bubbler filter screen for easy installation and resistance to debris.
- Trickle pattern on models 1401 and 1402; umbrella pattern on models 1404 and 1408.

* *See "Rain Bird Trade Warranty" section on page 172.*

Operating Range

- Flow: 0.25 to 2 GPM (0,06 to 0,46 m³/h; 0,02 to 0,13 l/s)
- Spacing: 1 to 3 feet (0,3 to 0,9 m)
- Pressure: 20 to 90 psi (1,5 to 6 Bars)

Dimensions

- ½" (15/21) female threaded inlet
- Height: 1" (2,5 cm)
- Top diameter: 1" (2,5 cm)

Models

- 1401: 0.25 GPM (0,06 m³/h; 0,02 l/s); full-circle, trickle pattern
- 1402: 0.5 GPM (0,11 m³/h; 0,03 l/s); full-circle, trickle pattern
- 1404: 1 GPM (0,23 m³/h; 0,06 l/s); full-circle, umbrella pattern
- 1408: 2 GPM (0,46 m³/h; 0,12 l/s); full-circle, umbrella pattern

I-40/41 Group

Our top-of-the-line rotor.
The favored choice at playing fields,
parks and commercial sites.

Across the globe, the I-40 is now the rotor of choice at stadiums, diamonds, practice fields, pitches and other playing surfaces. Plus, this long distance specialist is a proven performer at parks, campuses and commercial sites as well. How it became the favorite rotor for so many is really no surprise when you take a moment to look at all the impressive features it offers — including the ProTech™ safety system, two secondary nozzles that offer exceptional mid-range and close-in coverage, a stainless steel riser, heavy-duty retraction spring, factory-installed drain check valve, and a full 15-foot check height. With its unparalleled ability to deliver water accurately and efficiently at distances up to 74 feet, our top-of-the-line commercial rotor is sure to remain the number one choice at sports facilities for a long time to come.

FEATURES & BENEFITS

ProTech™ safety system

Small exposed heavy duty rubber cover and boot keeps playing areas safe

Primary nozzle system: 6 interchangeable nozzles

Uniform coverage with radius from 45 to 74 feet

Easy arc adjustment (40°–360°)

Up, down, wet or dry with through the top convenience

Stainless steel riser and spring

For long term positive retraction

Proven gear drive

Time-tested and now improved for even longer life

Patented VStat™ self-adjusting stator

No stator rings required, drives with more power and adds years to sprinkler life

Drain check valve for up to 15 feet elevation change

Saves water, reduces liability

MODELS

I-40, I-41* – Heavy-duty rotor
I-42, I-43* – High-speed heavy-duty rotor

DIMENSIONS

- Pop-up height: 3 ½" (9 cm)
- Overall height: 7 ⅞" (20 cm)
- Female inlet: 1" NPT or BSP
- Exposed diameter: 2" (5 cm)

OPERATING SPECIFICATIONS

- Discharge rate: 7.0 to 27.5 gpm (1.59 to 6.25 m³/hr; 26.5 to 104.1 l/min)
- Radius for I-40: 45' to 74' (13.7 to 22.6 m)
- Radius for I-42: 41' to 65' (12.5 to 19.8 m)
- Pressure range: 40 to 90 psi (2.8 to 6.2 bars; 275 to 620 kPa)
- Precipitation rates:** approximately .33" to .48" (8 to 12 mm) per hour
- Nozzle trajectory: 25°

OPTIONS AVAILABLE

- Add a turf cup to the I-40 or I-42 sprinkler with turf cup kit part number 46-0000. This kit allows the addition of a plug of living sod to the top of the riser. Perfect for areas where an invisible sprinkler is required.
- High-speed version (model: I-42/43)
- Reclaimed water cover
- Factory-installed nozzles

* Metric model numbers
** Calculated for 360° sprinkler

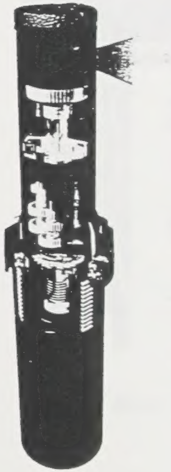
HUNTER LARGE RADIUS ROTOR

I-20 *Ultra*

Heavy duty, commercial grade features abound in a rotor that also provides the ultimate upgrade for residential projects.

Hunter has made an already superior product even better with the addition of our new FloStop™ feature that provides the convenience of easily stopping water flow through a single head without turning off the entire system. That alone would make the I-20 Ultra outstanding, but the combination of so many other great features is what places it head and shoulders above all other rotors in its class. Features like a full rack of both standard and low angle nozzles (the ideal solution for virtually any landscape situation)...tough, built-to-take-it construction...continuously reliable retraction from a heavy duty spring mechanism...up to 10 feet of elevation change handled by a standard water-saving drain check valve...plus, it's even protected by a full five-year warranty! If you're looking to upgrade over a typical residential grade rotor with a product that's sure to endure, this is where the search ends.

FEATURES & BENEFITS



Integral rubber cover

Stays put to keep play areas safe

Full rack of 8 standard and 4 low angle nozzles included

Continuously improved, honest performance, superior close-in coverage

NEW! FloStop™ Control

Allows stoppage of flow through an individual head while remainder of system is running

Easy arc adjustment (40°–360°)

Right at the top of the sprinkler

Continuously improved gear drive

Backed by over a decade of proven reliability

Commercial grade spring

Reliable retraction every time

Drain check valve for up to 10 feet elevation change

Saves water, reduces liability

MODELS

I-10 – Shrub
I-20 – 4" Pop-up (10 cm)

DIMENSIONS

- Overall height:
  I-10 – 7 ¾" (20 cm)
  I-20 – 7 ½" (19 cm)
- ¾" female inlet NPT
- Exposed diameter: 1 ½" (4 cm)

OPERATING SPECIFICATIONS

- Discharge rate: .9 to 8.2 gpm (0.20 to 1.86 m³/hr; 3.4 to 31.0 l/min)
- Radius: 25' to 51' (7.6 to 15.5 m)
- Pressure range: 30 to 70 psi (2.1 to 4.8 bars; 206 to 482 kPa)
- Precipitation rates: approximately .4" (10 mm) per hour at 50 psi (3.4 bars; 344 kPa) for spacing from 25' to 45' (7.6 to 13.7 m)
- Nozzle trajectory: standard – 25° low-angle – 13°
- Drain check valve for up to 10' (3.0 m) elevation change

OPTIONS AVAILABLE

- Reclaimed water cover
- Stainless steel riser (I-20 only)
- Factory-installed nozzles

HUNTER LARGE RADIUS ROTOR

Irrigation Equipment

Clark Tailings Recreational Facility

THE PROGRAMMING FLEXIBILITY AND BUILT-IN REMOTE CONTROL OF THE RME HAWK PUTS YOU IN CONTROL AND KEEPS YOU IN CONTROL.

- 4 independent programs with 5 start times each.
- Select 1 minute to 9 hours 59 minutes watering time.
- Water days based on 7 day or skip-by-day with up to 30 days between watering.
- Non-volatile memory holds the programs indefinitely during outages or shutdowns.
- No batteries to replace, ever.
- A "real time" clock holds the actual time during power outages without batteries.
- Ability to connect rain sensor and set which of your programs will respond to it.
- Automatic field wire fault detection senses short, shuts down station, reports fault, and moves to next programmed station.
- Programmable security codes.
- Built-in Test Mode.
- Ability to select usage of a pump on a per program basis.
- Water budgeting by increasing or decreasing station run times in 1% increments from 0% to 300% by program.
- Audible and visual alarm prompts for station faults.
- Electronic overload protection with automatic reset (no fuses or circuit breakers).
- Extra heavy-duty lightning and surge protected models available.

THE FLOW AND MONITORING CAPABILITIES OF THE RME HAWK WORK WITH ONLY A FLOW SENSOR, NO OTHER EQUIPMENT NEEDED.

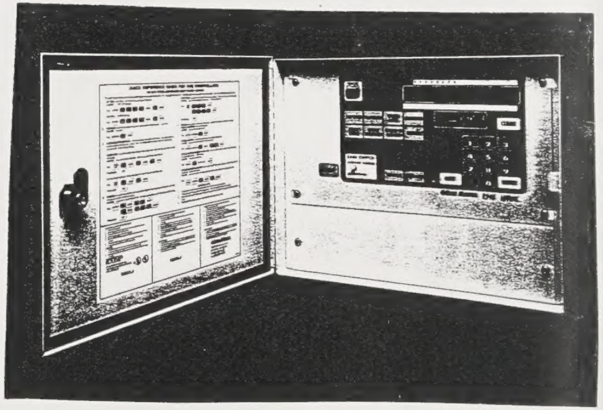
- Main line break detection.
- Unscheduled flow detection.
- Station upper limit flow detection with programmable and/or automatic limit.
- Totalizer feature for tracking water usage in gallons for specific time periods.
- Ability to view/monitor measured station flow in GPM.
- Ability to view status of rain sensor in the display.
- Programmable flow check delay of 1 to 6 minutes.
- Automatic flow "learn" mode for establishing station limits.
- Upper station limits can be set globally by percentage.
- Select either a normally open or normally closed master valve.

ONLY THE RME HAWK PROVIDES TRUE CYCLE AND SOAK TO ELIMINATE RUNOFF AND CONSERVE WATER.

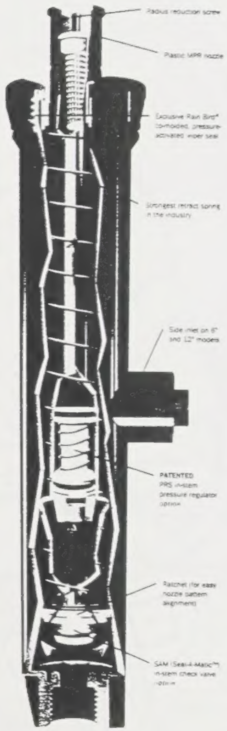
- Ability to select Cycle-and-Soak or conventional programming per program.
- Set "Run Time", "Max Cycle Time" and "Soak Time" per station.
- Displays Total Run Time per program which considers all soak delays, water budget percentage and interstation delay.
- Quick Station support for Cycle-and-Soak.

SPECIFICATIONS

- UL, CSA and FCC approved.
- 5 year limited warranty.
- 18 gauge steel housing with powder coated polyurethane finish.
- Basic unit measures 13" wide x 10" high x 5" deep. Larger enclosures are available.



RAINMASTER RME HAWK IRRIGATION CONTROLLER


Radius reduction screw
Plastic MPR nozzle
Exclusive Rain Bird® co-molded, pressure-activated wiper seal
Strongest retract spring in the industry
Side inlet on 6" and 12" models
PATENTED PRS in-stem pressure regulator option
Ratchet (for easy nozzle pattern alignment)
SAM (Seal-A-Matic™) in-stem check valve option

RAIN BIRD

Pop-Up Spray Sprinklers

1800 SERIES

2", 3", 4", 6", 12" (5 cm; 7,6 cm; 10 cm; 15 cm; 30 cm)

Primary Application

Industry's leading series of spray sprinklers for turf and shrub applications.

Features

- Exclusive co-molded, pressure-activated wiper seal prevents excessive flow-by and water waste. Keeps debris from entering upon retraction.
- Strongest stainless steel spring in the industry provides reliable stem retraction.
- Ratchet mechanism on all models allows easy nozzle pattern alignment without tools.
- Pre-installed 1800 Pop-Top™ flush plug blocks debris from entering after flushing. Allows for easy nozzle installation.
- Plastic and stainless steel materials resist corrosion.
- Internal parts removable from the top of the sprinkler for easy servicing.
- Side and bottom inlets featured on 1806 and 1812 models.
- Five-year trade warranty.*

* *See "Rain Bird Trade Warranty" section on page 172.*

Operating Range

- Spacing: 3 to 20 feet (0,9 to 6,1 m)
- Pressure: 15 to 70 psi (1 to 4,8 Bars)

Specifications

- Flow-by: 0 at 8 psi (0,6 Bars) or greater; 0.03 GPM (0,01 m³/h; 0,003 l/s) otherwise

Dimensions

- ½" (15/21) female threaded inlets
- Body height:
  1802: 4" (10 cm)
  1803: 4⅞" (12 cm)
  1804: 6" (15 cm)
  1806: 9⅜" (24 cm)
  1812: 16" (40 cm)
- Exposed surface diameter: 2¼" (5,7 cm)

Models

- 1802: 2" pop-up height (5 cm)
- 1803: 3" pop-up height (7,6 cm)
- 1804: 4" pop-up height (10 cm)
- 1806: 6" pop-up height (15 cm)
- 1812: 12" pop-up height (30 cm)

1800 series

How to Specify:

1804 - B15H

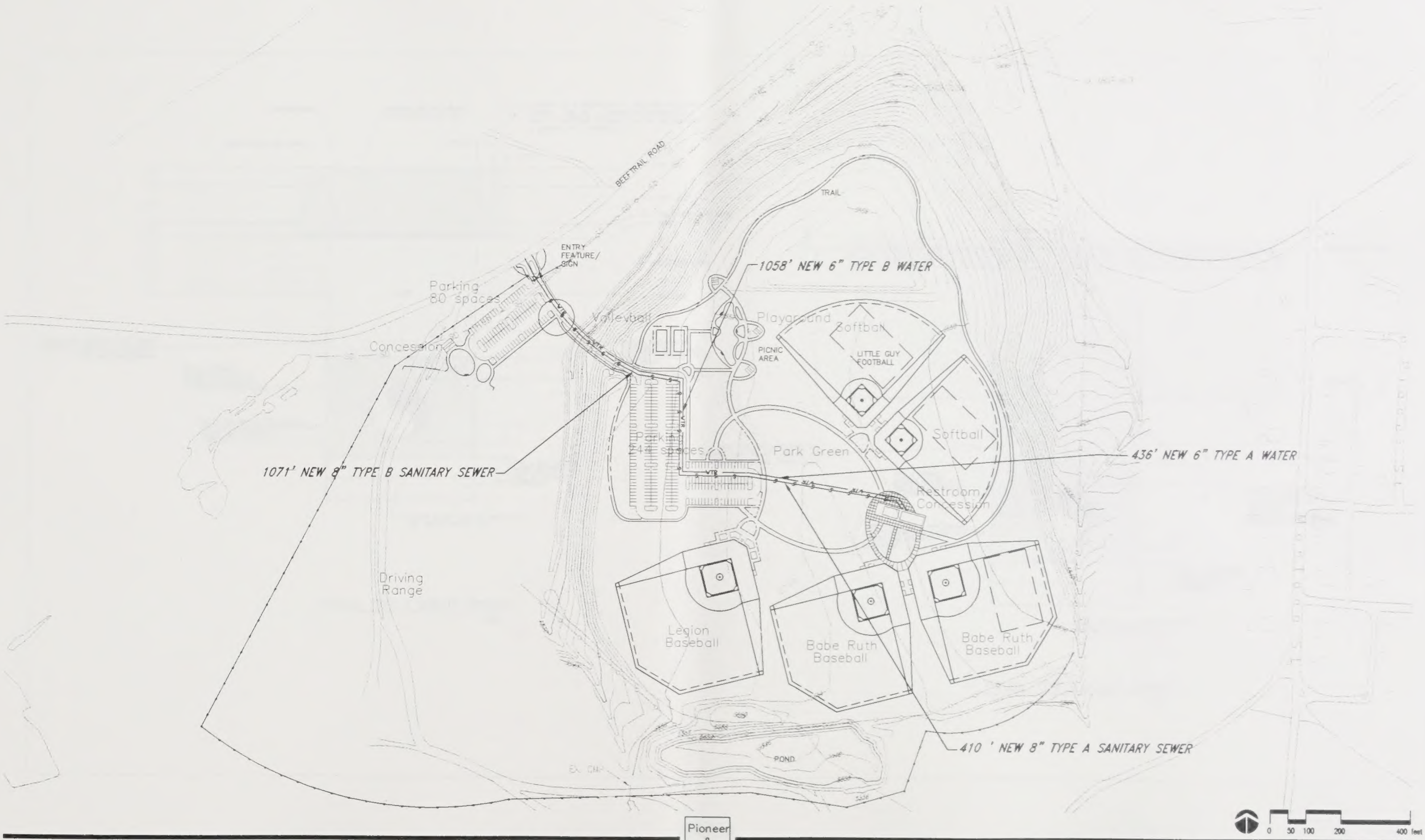
Model	Nozzle Series/Pattern
1804: 4" (10 cm) pop-up height	B15H 15 Series brass MPR nozzle with half-circle pattern

1997-1998 *catalog*

spray heads 17

Utility Master Plan

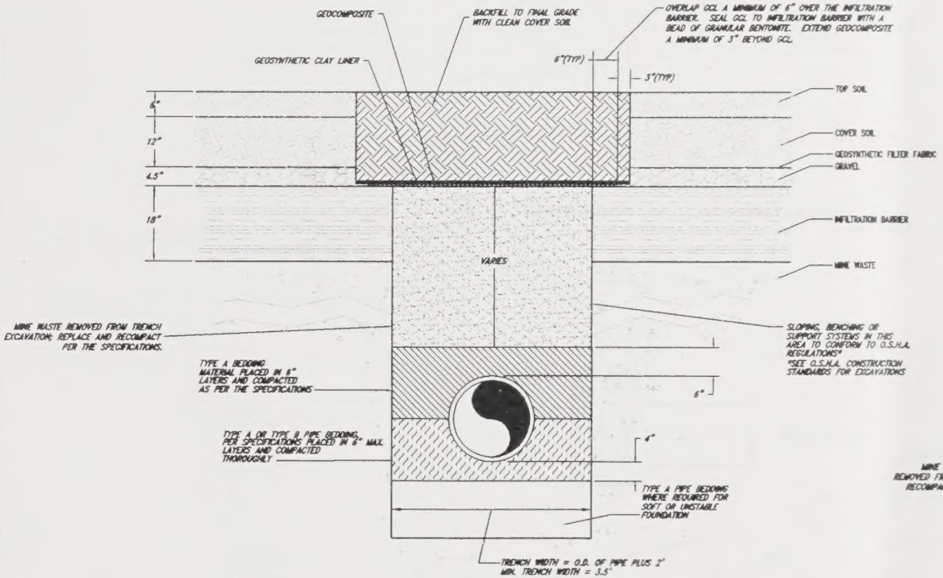
Clark Tailings Recreational Facility


BEEFTRAIL ROAD
TRAIL
ENTRY FEATURE/ SIGN
Parking 80 spaces
Concession
Volleyball
Playground
PICNIC AREA
Softball
LITTLE GUY FOOTBALL
Softball
1058' NEW 6" TYPE B WATER
Parking 244 spaces
Park Green
436' NEW 6" TYPE A WATER
Restroom Concession
1071' NEW 8" TYPE B SANITARY SEWER
Driving Range
Legion Baseball
Babe Ruth Baseball
Babe Ruth Baseball
410 ' NEW 8" TYPE A SANITARY SEWER
POND
0 50 100 200 400 feet

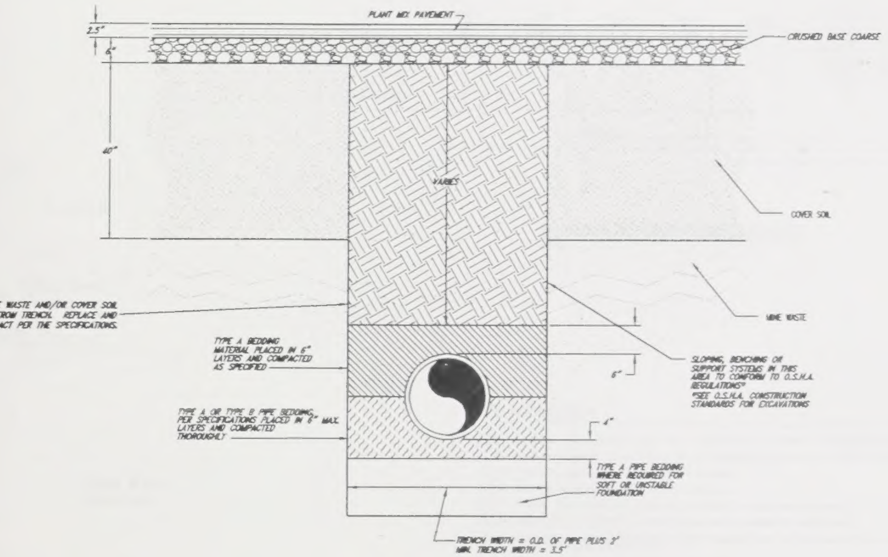
Pioneer
◦
EDAW

2 - 3 - 98

ARCO ENVIRONMENTAL REMEDIATION, L.L.C.


GEOCOMPOSITE
BACKFILL TO FINAL GRADE WITH CLEAN COVER SOIL
OVERLAP GCL A MINIMUM OF 6" OVER THE INFILTRATION BARRIER. SEAL GCL TO INFILTRATION BARRIER WITH A BEAD OF GRANULAR BENTONITE. EXTEND GEOCOMPOSITE A MINIMUM OF 3" BEYOND GCL.
GEOSYNTHETIC CLAY LINER
6"(TYP)
3"(TYP)
6"
12"
4.5"
18"
TOP SOIL
COVER SOIL
GEOSYNTHETIC FILTER FABRIC
GRAVEL
INFILTRATION BARRIER
MINE WASTE
VARIES
MINE WASTE REMOVED FROM TRENCH EXCAVATION; REPLACE AND RECOMPACT PER THE SPECIFICATIONS.
SLOPING, BENCHING OR SUPPORT SYSTEMS IN THIS AREA TO CONFORM TO O.S.H.A. REGULATIONS*
*SEE O.S.H.A. CONSTRUCTION STANDARDS FOR EXCAVATIONS
TYPE A BEDDING MATERIAL PLACED IN 6" LAYERS AND COMPACTED AS PER THE SPECIFICATIONS
6"
TYPE A OR TYPE B PIPE BEDDING, PER SPECIFICATIONS PLACED IN 6" MAX. LAYERS AND COMPACTED THOROUGHLY
4"
TYPE A PIPE BEDDING WHERE REQUIRED FOR SOFT OR UNSTABLE FOUNDATION
TRENCH WIDTH = O.D. OF PIPE PLUS 2'
MIN. TRENCH WIDTH = 3.5'

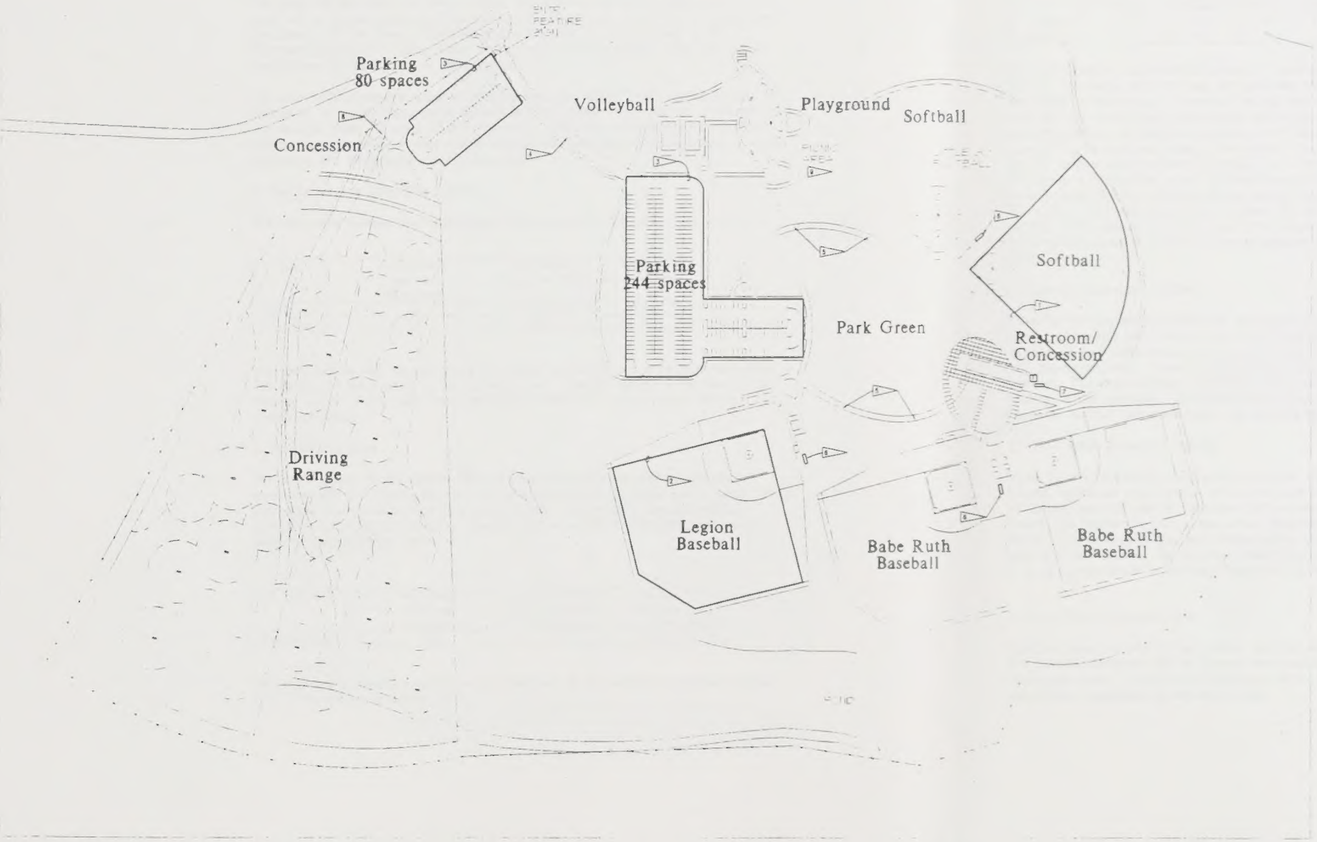
TYPICAL TYPE A UTILITY TRENCH
N.T.S.

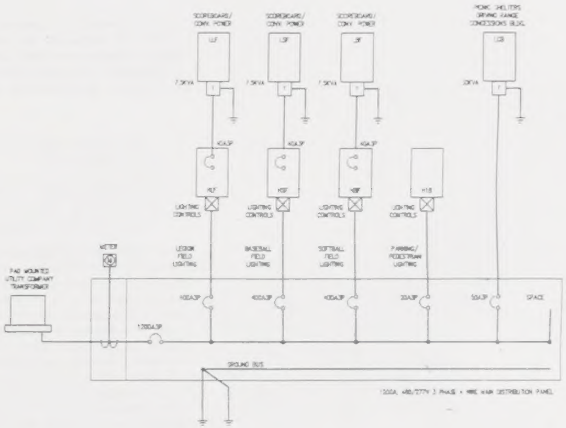

PLANT MIX PAVEMENT
2.5"
6"
CRUSHED BASE COARSE
40"
VARIES
COVER SOIL
MINE WASTE
MINE WASTE AND/OR COVER SOIL REMOVED FROM TRENCH. REPLACE AND RECOMPACT PER THE SPECIFICATIONS.
TYPE A BEDDING MATERIAL PLACED IN 6" LAYERS AND COMPACTED AS SPECIFIED
6"
SLOPING, BENCHING OR SUPPORT SYSTEMS IN THIS AREA TO CONFORM TO O.S.H.A. REGULATIONS*
*SEE O.S.H.A. CONSTRUCTION STANDARDS FOR EXCAVATIONS
TYPE A OR TYPE B PIPE BEDDING, PER SPECIFICATIONS PLACED IN 6" MAX. LAYERS AND COMPACTED THOROUGHLY
4"
TYPE A PIPE BEDDING WHERE REQUIRED FOR SOFT OR UNSTABLE FOUNDATION
TRENCH WIDTH = O.D. OF PIPE PLUS 2'
MIN. TRENCH WIDTH = 3.5'

TYPICAL TYPE B UTILITY TRENCH
N.T.S.

Electrical Schematic Plan

Clark Tailings Recreational Facility


ENTRY FEATURE
Parking
80 spaces
Concession
Volleyball
Playground
Softball
PICNIC AREA
Parking
244 spaces
Park Green
Softball
Restroom/
Concession
Driving
Range
Legion
Baseball
Babe Ruth
Baseball
Babe Ruth
Baseball
1
2
3
4
5
6
7
8
9


SCOREBOARD/
CONV. POWER
SCOREBOARD/
CONV. POWER
SCOREBOARD/
CONV. POWER
PICNIC SHELTERS
DRIVING RANGE
CONCESSIONS BLDG.
LLF
LSF
LSF
LCB
7.5KVA
7.5KVA
7.5KVA
30KVA
T
40A3P
40A3P
40A3P
HLF
HSF
HSF
H1B
LIGHTING
CONTROLS
LIGHTING
CONTROLS
LIGHTING
CONTROLS
LIGHTING
CONTROLS
METER
M
LEGION
FIELD
LIGHTING
BASEBALL
FIELD
LIGHTING
SOFTBALL
FIELD
LIGHTING
PARKING/
PEDESTRIAN
LIGHTING
PAD MOUNTED
UTILITY COMPANY
TRANSFORMER
400A3P
400A3P
400A3P
20A3P
50A3P
SPACE
1200A3P
GROUND BUS
1200A, 480/277V 3 PHASE 4 WIRE MAIN DISTRIBUTION PANEL

SCHEMATIC ONE-LINE DIAGRAM

NO SCALE

FLAG NOTES:

1. LEGION FIELD ILLUMINATED TO CLASS B LEVEL OF PLAY. 50 HORIZONTAL FOOT-CANDLES INFIELD/ 30 HORIZONTAL FOOT-CANDLES OUTFIELD.
2. SOFTBALL FIELD ILLUMINATED TO CLASS B LEVEL OF PLAY; 30 HORIZONTAL FOOT-CANDLES INFIELD, 20 HORIZONTAL FOOT-CANDLES OUTFIELD.
3. PARKING LOT ILLUMINATED TO 0.8 AVERAGE HORIZONTAL FOOT-CANDLES.
4. ENTRY DRIVE ILLUMINATED TO 0.5 AVERAGE HORIZONTAL FOOT-CANDLES.
5. PEDESTRIAN SIDEWALK ILLUMINATED TO 0.6 HORIZONTAL FOOT-CANDLES, 1.0 AVERAGE VERTICAL FOOT-CANDLES.
6. 400A, 480/277Y LIGHTING PANEL WITH 120/208V MINI-POWER ZONE FOR SCOREBOARD AND CONVENIENCE POWER.
7. 1200A, 480/277V 3 PHASE MAIN DISTRIBUTION PANEL, 480/277V PARKING LOT PANEL AND 120/208V MINI-POWER ZONE FOR CONCESSION BUILDING, PICNIC SHELTERS AND DRIVING RANGE.
8. CONVENIENCE ELECTRICAL (120V) POWER PROVIDED AT DRIVING RANGE.
9. CONVENIENCE ELECTRICAL (120V) POWER AND LIGHTING PROVIDED AT PICNIC SHELTERS.

Consulting Engineers
Job No. 14821

0 50 100 200 400 feet

Pioneer
○
EDAW
2 - 2 - 98

ARCO ENVIRONMENTAL REMEDIATION, L.L.C.

Electrical Schematic Narrative

Clark Tailings Recreational Facility

Clark Tailings Recreational Facility

Electrical and Lighting Systems

A. Electrical Service and Distribution

Power for the facility will be supplied from a Montana Power Company transmission line that runs along the south side of Beef Trail Road. A three phase 480Y/277-volt electrical service will be provided via a power company transformer located near the Restroom/Concession building. Metering equipment and a main distribution panelboard will also be located near the Restroom/Concession building.

The main 480 volt panel, will feed a smaller 480/277 volt parking lot lighting panel. This panel will be located adjacent to the main panel. In addition, a small 30 kVA step-down transformer with an integral 120/208V distribution panel will provide power to the Restroom/Concessions building, Picnic Shelters and the Driving Range. This panel will be located next to the parking lot lighting panel.

The main 480V distribution panel will feed three smaller 480/277-volt lighting panels, one located at the Legion Field, one in between the two Softball Fields and one in between the two Baseball Fields. A small 7.5 kVA step-down transformer with an integral 120/208V distribution panel will be located next to each of the three sports lighting panels to provide scoreboard and convenience power at each field.

B. Parking Lot and Entry Drive Lighting

The table below outlines the recommended lighting levels for the parking and entry drive.

Area	Avg. Horizontal Light Level (foot-candles)	Avg. Vertical Avg. to Min. Ratio	Maximum Max. to Min. Ratio
Parking Lots	0.8	4 to 1	10 to 1
Entry Drive	0.5	6 to 1	12 to 1

Low-glare fixtures with cut-off optics will provide the parking and entry drive illumination. The fixtures will be mounted to 25' tall steel poles. Concrete bases for the poles will be installed outside of the paved areas near the perimeter curb and/or in the interior landscaped islands.

C. Pedestrian Lighting

The central ellipse shaped sidewalk and the plaza areas near the sports fields will be illuminated with pole lighting fixtures. The pole lights will be 25 to 30 feet in height. Glare from these fixtures will be kept to a minimum while still providing adequate vertical illumination for safety and security. The table below outlines the recommended lighting levels for the pedestrian lighting.

Area	Avg. Horizontal Light Level (foot-candles)	Avg. Vertical Light Level (foot-candles)	Maximum Horizontal Ave. to Min. Ratio
Pedestrian Path	0.6	4 to 1	10 to 1

The parking and pedestrian lighting will be controlled via an astronomic timeclock located next to the parking lot lighting panel.

D. Sports Lighting

The Legion Baseball field and one Softball Field will be illuminated. The lighting for the Legion field will meet Class III requirements while the lighting for the Softball field will meet Class IV requirements. Class III illumination standards apply from elementary school through amateur league levels of play, while Class IV standards apply from recreational events through training type facilities. These lighting level requirements are outlined in the table below.

Field/Class of Play	Horizontal (foot-candles)		Vertical (foot-candles)		Horiz. Uniformity Max. to Min	
	Infield	Outfield	Infield	Outfield	Infield	Outfield
Legion/III	50	30	40	25	2.0	2.5
Softball/IV	30	20	25	15	3.0	3.5

The sports lighting equipment will consist of clusters of aimable high wattage metal halide fixtures mounted to 90 to 80 feet tall galvanized steel poles. All of the lighting fixtures are pre-aimed at the factory. Pre-aimed fixtures decreases installation time and helps insure that the foot-candle levels requirements will be met with little, to no on site adjustments. To ease maintenance, an electrical enclosure which houses the ballasts, capacitors and fuses is mounted to the pole and closer to the ground. The recommended manufacturer for this type of lighting system is Musco Lighting. Due to the site's highly visible location, Musco's TLC series of fixtures will provide the least amount of glare and light pollution. Musco's Level 8 series of lighting fixtures will also provide glare control, but not to the extent of the TLC system. The difference in cost between the TLC and Level 8 lighting systems is outlined in the opinion of probable cost. The sports lighting will be controlled from the concessions building via contactors located adjacent to each the respective sports lighting panel.

E. Restroom/Concession Building

Power for the concessions building will be supplied from a 30 kVA transformer with an integral distribution panel located next to the main distribution panel. The Concession Building will have convenience power for small food preparation appliances, (microwave, hot-dog cooker, etc.). Power for high electrical demand ovens or ranges will not be provided. Fluorescent lighting will be used throughout the building, with vandal resistant housings in the restrooms. Occupancy sensors may be used to control the restroom lighting. Power for exhaust fans, hand dryers and plumbing chase unit heaters will also be provided.

F. Picnic Shelter Power and Lighting

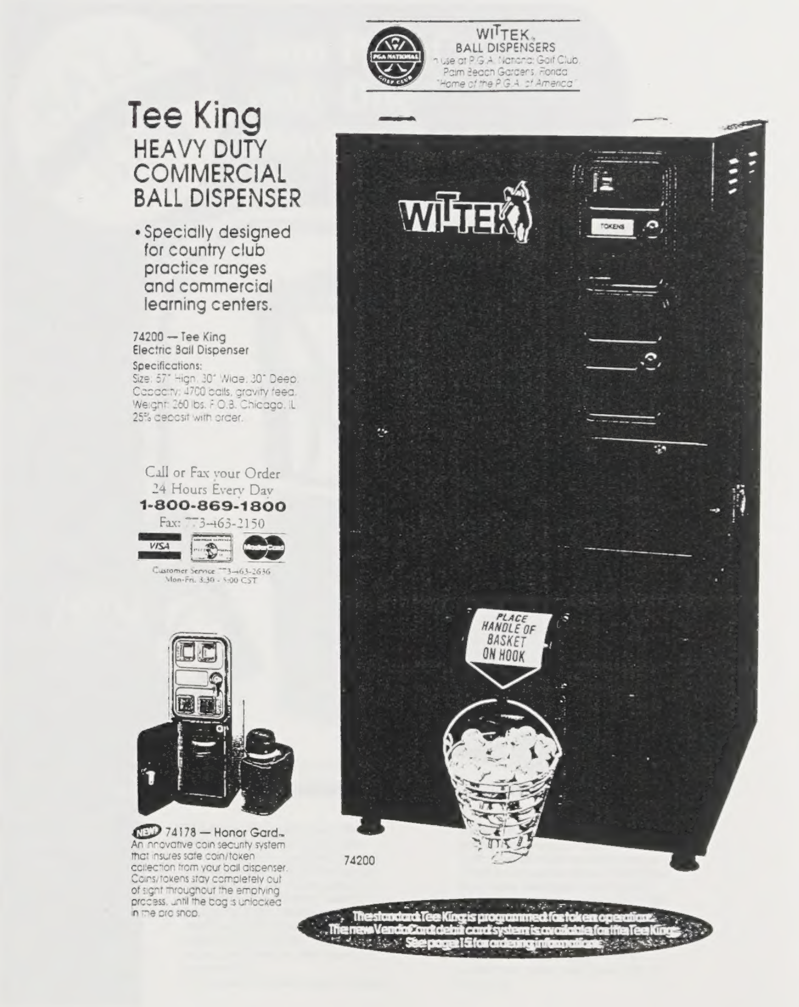
Power for the concessions building will be supplied from a 30 kVA transformer with an integral distribution panel located next to the main distribution panel. Each picnic shelter will be equipped with one GFI receptacle and one vandal resistant metal halide lighting fixture. As required by code a local circuit disconnect switch will be installed on the picnic shelter. The area under the picnic shelter will be illuminated to an average horizontal light level of 5 foot-candles. An occupancy sensor can be installed to control the shelter lighting. If an occupancy sensor is desirable, fluorescent lighting will be used instead of metal halide.

G. Driving Range Electrical Power

Electrical power for the golf ball vending machines will be provided at the driving range via the 30 kVA transformer with an integral distribution panel located next to the main distribution panel. A local circuit disconnect switch will also be installed near the convenience receptacles as required by code.

Driving Range Equipment

Clark Tailings Recreational Facility



WITTEK
BALL DISPENSERS
In use at P.G.A. National Golf Club,
Palm Beach Gardens, Florida
"Home of the P.G.A. of America"

Tee King
HEAVY DUTY COMMERCIAL BALL DISPENSER

- Specially designed for country club practice ranges and commercial learning centers.

74200 — Tee King
Electric Ball Dispenser
Specifications:
Size: 57" High, 30" Wide, 30" Deep.
Capacity: 4700 balls, gravity feed.
Weight: 260 lbs. F.O.B. Chicago, IL
25% deposit with order.

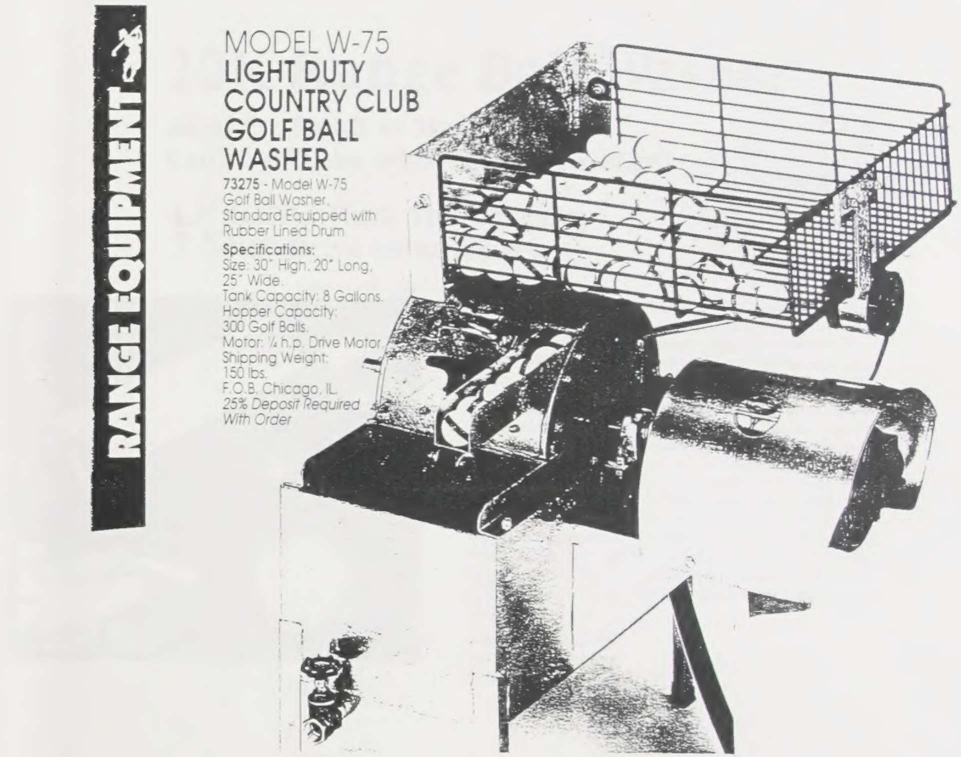
Call or Fax your Order
24 Hours Every Day
1-800-869-1800
Fax: 773-463-2150
VISA
Customer Service 773-463-2636
Mon-Fri. 8:30 - 5:00 CST

NEW! 74178 — Honor Gard™
An innovative coin security system that insures safe coin/token collection from your ball dispenser. Coins/tokens stay completely out of sight throughout the emptying process, until the bag is unlocked in the pro shop.

74200

The standard Tee King is programmed for token operation.
The new VendaCard debit card system is available for the Tee King.
See page 15 for ordering information.

WITTEK GOLF SUPPLY CO.



MODEL W-75
LIGHT DUTY COUNTRY CLUB GOLF BALL WASHER

73275 - Model W-75
Golf Ball Washer,
Standard Equipped with
Rubber Lined Drum

Specifications:
Size: 30" High, 20" Long,
25" Wide.
Tank Capacity: 8 Gallons.
Hopper Capacity:
300 Golf Balls.
Motor: ¼ h.p. Drive Motor.
Shipping Weight:
150 lbs.
F.O.B. Chicago, IL.
25% Deposit Required
With Order

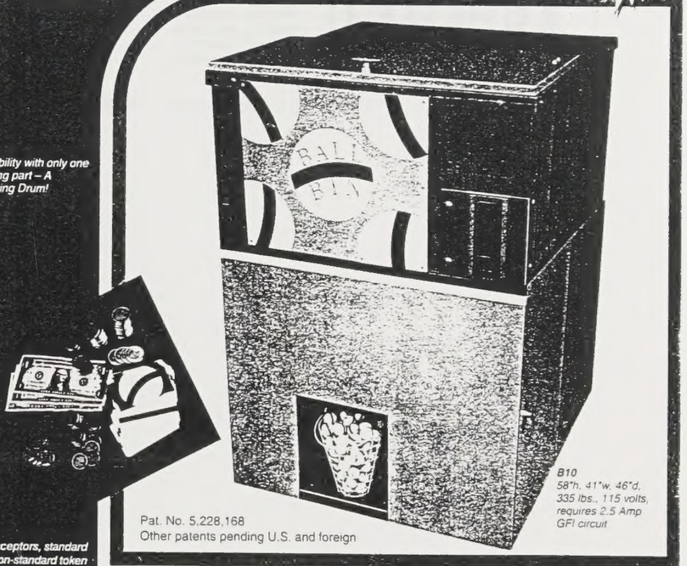
WITTEK GOLF SUPPLY CO.

BALL BIN

Jam Proof - only One Moving Part

3 YEAR WARRANTY!

Reliability with only one moving part – A Rotating Drum!



B10
58"h, 41"w, 46"d,
335 lbs., 115 volts,
requires 2.5 Amp
GFI circuit

Pat. No. 5,228,168
Other patents pending U.S. and foreign

Bill acceptors, standard and non-standard token mechanisms, pre-programmed debit cards or reuseable credit card systems available.

This is the most economical, convenient and maintenance-free - only one moving part - golf ball dispenser available today. The Ball Bin is fully automatic and can be actuated by numerous mechanisms. Gaining in popularity is the reprogrammable credit card that allows counter personnel to program the credit card equal to the value of cash given by the customer.

The software support package allows communication with your center's accounting programs database and pc's. Special features allows senior citizens discounts, special "slow" time discounts. Generates mailing lists and usage reports. Management can now have almost airtight accountability and cash drawer balance.

Consult with our inside sales staff for a complete cost analysis on the system you have been dreaming of for years.

HOLLROCK EQUIP. INC.

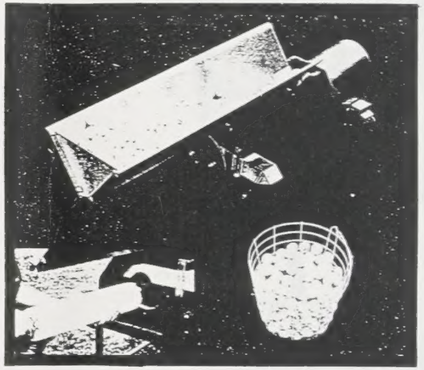
20K Range Ball Washer

Ideal for Small to Medium Country Clubs with Warm Up Ranges

NEW

Lifetime Wash Tub Warranty
3 Year Drive Motor Warranty

Patent #4,805,251



"Affordable Quality" with a "Peace of Mind Warranty" will make this ball washer an easy purchase decision for any Pro or Manager. A virtually indestructible, LIFETIME WARRANTY Polypropylene tub, has eliminated the very reason why he is shopping for one right now...NO MORE RUST OUT LEAKS!

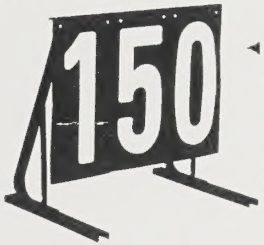
Designed to deliver more than 20,000 balls per hour, it's just perfect for the demands of the small to medium size country club warm-up range. You'll love the durable wheels that easily allows the operator to quickly roll it to where it's needed, then roll back into the corner when the washing job is done. When adding water, a strategically located weep hole will assure proper water level. The balls are not just "spun" through the washer, they actually change direction and the rotation axis 3 times before discharge! No metal rails inside to chip the finish or paint off the balls, it's a molded poly-track assembly that prolongs the life of the range ball. Inset photo shows ease of brush removal.

20K: *9 Amps, 115 Volts*
92 lbs., ½ Horsepower
Height of Loading Hopper 37"

HOLLROCK EQUIP INC.

Driving Range Equipment

Clark Tailings Recreational Facility



◄ Practice Range Distance Signs

These new distance markers are the most durable you'll find!

- Highly visible, in any distance from 50 to 275 yards in increments of 25 yards.
- Stand is made of heavy gauge, black, powder coated steel.
- The three flaps are 3/8" (1 cm) thick, black rubber with molded-in white rubber numbers ... as tough and long-lasting as semi-truck mud flaps.
- Rugged, yet easy to move for ball retrieval and mowing.

Complete kit consists of frame, numbers and assembly hardware.

Weight each: 34 lbs.

#10200-01 - 100 Yards
#10200-02 - 125 Yards
#10200-03 - 150 Yards
#10200-04 - 175 Yards
#10200-05 - 200 Yards
#10200-06 - 225 Yards
#10200-07 - 250 Yards
#10200-08 - 275 Yards

WITTEK GOLF SUPPLY CO.

Range Pails and Baskets

The most popular range pails and utility baskets in the world are made by Wittek. The standard of the industry, these durable pails and baskets are made of extra heavy gauge steel and feature spot welded construction for added strength.

E-Z
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6
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Three Colors to Choose From—

Range pails are available in original zinc, and for that special look — yellow and fairway green in a durable plastic/rubber coating. Utility baskets are available in yellow and fairway green plastic/rubber coating only. Use this easy to order chart.

Pail #	Zinc	Yellow	Fairway Green	Capacity	Top Height	Top Width
1	76210	76211	76212	15-20 Balls	4"	5½"
2	76220	76221	76222	25-30 Balls	5"	7"
3	76230	76231	76232	35-40 Balls	6½"	7½"
4	76240	76241	76242	45-50 Balls	7"	8"
5	76250	76251	76252	55-60 Balls	8"	8½"
6	76260	76261	76262	65-75 Balls	8¼"	8¾"
7	76270	76271	76272	80-85 Balls	9¾	9½"
Utility Basket	**N/A**	**Yellow**	**Fairway Green**	**Capacity**	**Top Height**	**Top Width**
P-1	—	76105	76205	95-105 Balls	4½"	12"
P-2	—	76104	76204	135-145 Balls	6¼"	12½"
P-3	—	76103	[illegible]	175-200 Balls	7½"	13"
2-1	—	76101	[illegible]	300-350 Balls	12½"	14½"
2-2	—	76102	[illegible]	400-450 Balls	13½"	15"

WITTEK GOLF SUPPLY CO.

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COMMUNITY SERVICES BUREAU

FINAL
CONSTRUCTION QUALITY ASSURANCE PLAN FOR THE CLARK TAILINGS WASTE MANAGEMENT AREA

Prepared for:

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

April 1997

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CONSTRUCTION QUALITY ASSURANCE PLAN FOR THE CLARK TAILINGS WASTE MANAGEMENT AREA

Prepared for:

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

Prepared by:

Pioneer Technical Services, Inc.
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Butte, Montana 59702

April 1997

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1.0 INTRODUCTION

This Construction Quality Assurance (CQA) Plan details the quality assurance procedures to be utilized during the installation of the soil cap and other materials at the Clark Tailings Waste Management Area (CTWMA). Environmental conditions and closure of this area are being addressed along with the adjacent Old Butte-Silver Bow Landfill as a combined solid waste management unit under the Resource Conservation and Recovery Act (RCRA) and applicable State of Montana solid waste regulations. Montana is an Environmental Protection Agency (EPA) approved State under RCRA and, therefore, has regulatory primacy on solid waste issues, including the Old Butte-Silver Bow Landfill/Clark Tailings combined waste management unit. The combined sites are being addressed under the assessment of corrective measures process defined in the Administrative Rules of Montana (ARM) 17.50.710(6). This CQA Plan has been prepared to address the State of Montana requirements published in the ARM 17.50.506(12) et seq.; this plan has been approved by the Montana Department of Environmental Quality (MDEQ). (Since there will be different parties involved in the installation of the cap, a separate CQA Plan for the Old Butte-Silver Bow Landfill cap was prepared and submitted previously [Pioneer, 1996a].)

Because native soil will be used to construct the landfill cap, this manual addresses primarily quality assurance. Quality assurance testing is conducted by a party independent of the cap installers.

Quality assurance and quality control are defined as follows:

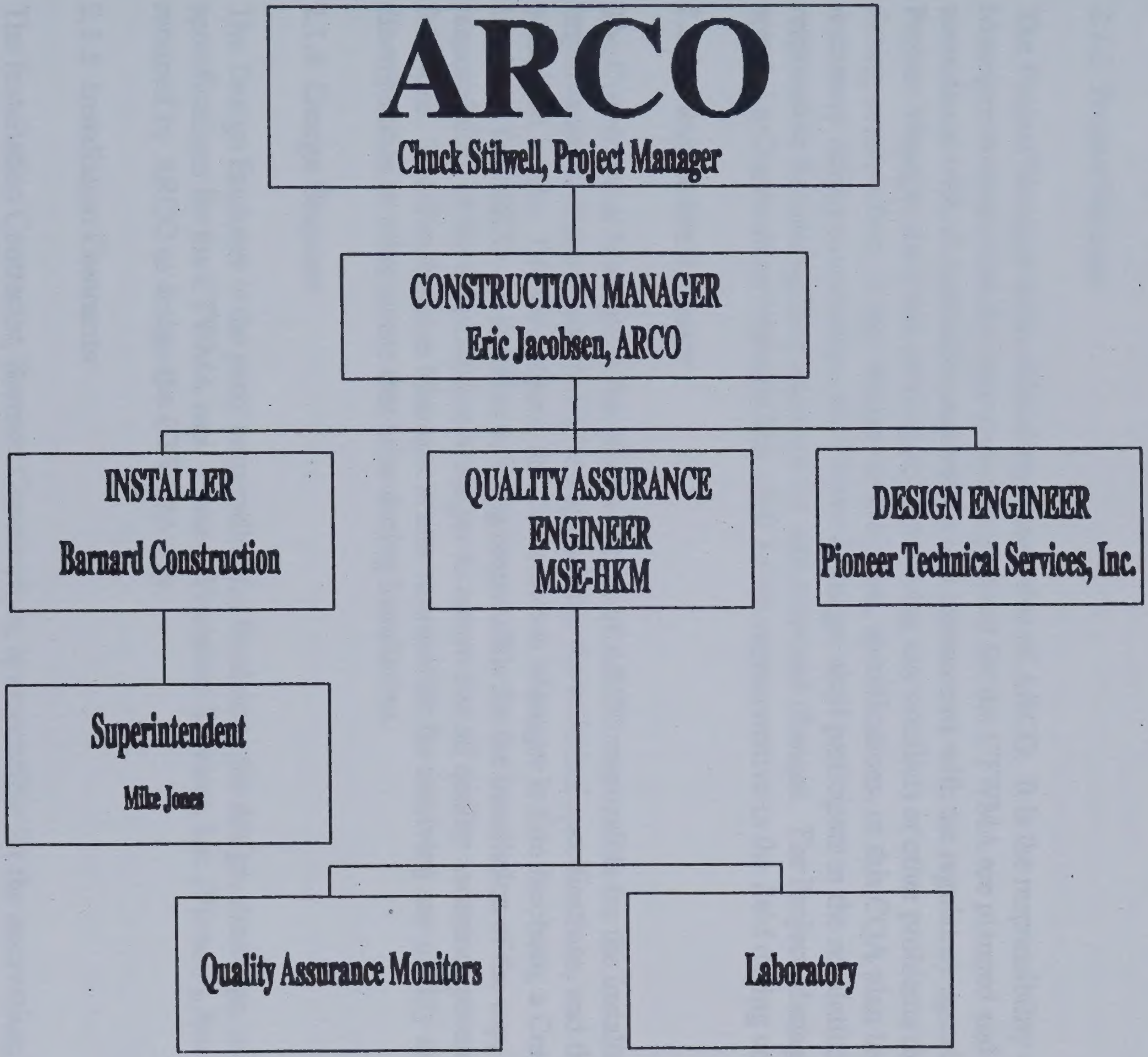
- Quality Assurance - A planned and systematic pattern of all means and actions designed to provide adequate confidence that materials or services meet contractual and regulatory requirements. This is typically performed to assure the purchaser, owner, and/or regulatory agencies that delivered materials or services are of desired quality.

- Quality Control - Those actions that provide a means to measure and regulate the characteristics of a material or service to meet contractual and regulatory requirements. This typically is performed by or for the provider of materials or services as a control mechanism on the quality of the provider's efforts.

2.0 RESPONSIBILITY AND AUTHORITY

2.1 PARTIES INVOLVED IN CQA PROGRAM

The parties involved in the construction of the CTWMA, and their individual responsibilities, are identified in this section. The organizational chart identifying lines of communication and authority for this project is shown on Figure 2-1.


ARCO
Chuck Stilwell, Project Manager
CONSTRUCTION MANAGER
Eric Jacobsen, ARCO
INSTALLER
Barnard Construction
QUALITY ASSURANCE ENGINEER
MSE-HKM
DESIGN ENGINEER
Pioneer Technical Services, Inc.
Superintendent
Mike Jones
Quality Assurance Monitors
Laboratory

PIONEER
TECHNICAL SERVICES, INC.

FIGURE 2-1

CTWMA CONSTRUCTION ORGANIZATION CHART

SCALE: NTS
DATE: 12/19/96

2.1.1 Owner/Operator

Ownership of the CTWMA is currently being transferred to Butte-Silver Bow County (BSB) from Inland Properties. Under an agreement between the Atlantic Richfield Company (ARCO) and BSB, ARCO is the Operator of the CTWMA for this project (placing Lower Area One [LAO] materials and constructing the cap and ancillicary improvements at the CTWMA). The Project Manager and Construction Manager are the official representatives of ARCO.

2.1.2 Project Manager

The Project Manager is the official representative of ARCO. It is the responsibility of the Project Manager to ensure that the improvements planned for the CTWMA are planned and conducted in accordance with all applicable regulations and agreements with the regulatory agencies. The Project Manager shall also participate is resolving any conflicts or other problems that arise during construction. If any changes to the plans, specifications, or this CQA plan become necessary during construction, the Project Manager shall participate in the resolution and shall be responsible for issuing final approval for any proposed changes. The Project Manager shall appoint a Construction Manager that shall be his representative in the field during construction.

2.1.3 Construction Manager

The Construction Manager is the representative of ARCO responsible for the installation of the improvements in accordance with the regulations, the technical specifications, and the provisions contained herein. For this project, the Construction Manager is Eric Jacobsen, a Construction Engineer for ARCO. In addition to being responsible for the installation of the cap, it is the responsibility of the Construction Manager to assure that all quality assurance protocols are followed. The Construction Manager is also responsible for resolving any quality assurance discrepancies or other issues that arise during installation.

2.1.4 Design Engineer

The Design Engineer is the party responsible for furnishing the design, drawings, plans, and specifications for the CTWMA cap. Pioneer Technical Services, Inc. (Pioneer), has been retained by ARCO to design the CTWMA cap.

2.1.5 Installation Contractor

The Installation Contractor, Barnard Construction, is responsible for the excavation, transport, and installation of the materials comprising the cap in accordance with the specifications and the provisions contained herein and any site specific variations to the plan as required by the Quality Assurance Engineer. The Installation Contractor will identify a Superintendent who will be responsible for the field crew, including laborers and equipment operators. The Superintendent will communicate to the Quality Assurance Engineer regarding progress, difficulties encountered, and any variations from the installation plan. The Installation Contractor's duties

include the following: grading; surveying for grade and cover thickness control; moisture control for materials installation; transporting, placing, and compacting cap materials; final grading; providing and incorporating soil amendments; and fertilizing, seeding, and mulching.

2.1.6 Quality Assurance Engineer

MSE-HKM, Inc., will serve as the Quality Assurance contractor for ARCO. MSE-HKM shall identify a lead engineer to serve as the Quality Assurance Engineer. The Quality Assurance Engineer will be responsible for certifying that the CTWMA cap has been installed in accordance with the regulations and the provisions contained herein. Furthermore, the Quality Assurance Engineer is the individual responsible for observing, testing, and documenting activities related to the quality assurance for the installation of the CTWMA cap and will work on behalf of the Construction Manager to ensure compliance with the quality assurance program contained herein. The Quality Assurance Engineer may be assisted by Quality Assurance Monitors who would provide construction observation, testing, and documentation. The Quality Assurance Engineer will employ the services of a qualified soils testing laboratory to conduct the soils analyses required by this plan.

2.1.7 Soils Testing Laboratory

The Soils Testing Laboratory is a laboratory hired by ARCO or the Quality Assurance Engineer to perform quality assurance soils tests. The term "Laboratory" is used to denote the official representative of the Soils Testing Laboratory throughout this plan.

2.2 RECOMMENDED PERSONNEL QUALIFICATIONS

2.2.1 Construction Manager

The selection of the Construction Manager is the direct responsibility of ARCO. The Construction Manager should be experienced in overseeing large earthmoving projects and the placement of native soil caps.

2.2.2 Design Engineer

The engineer representing the Design Engineer must be a Professional Engineer with the State of Montana and qualified to design a soil cap that fulfills ARCO's operational requirements and complies with accepted design practices and regulatory standards.

2.2.3 Installation Contractor

The Installation Contractor will be experienced in soil cap construction and knowledgeable about low permeability soil cap construction techniques.

2.2.4 Quality Assurance Engineer

The Quality Assurance Engineer should be a Professional Engineer licensed in the State of Montana with experience in geotechnical engineering, construction, and interpretation of the results of field and laboratory testing. The Quality Assurance Engineer should have a history which demonstrates familiarity with soil cap components and construction techniques which includes soil design methods and procedures.

2.2.5 Soils Testing Laboratory

The Soils Testing Laboratory will have experience in testing soils and will be familiar with American Society for Testing and Materials (ASTM) and other applicable test standards. The Soils Testing Laboratory is responsible for ensuring that tests are performed in accordance with applicable methods and standards, for following internal quality control procedures, for maintaining sample chain-of-custody records, and for reporting data. This Soils Testing Laboratory must also be responsive to the testing needs of the project by providing test results within a reasonable time.

2.3 PROJECT MEETINGS

To attain a high degree of quality during facility construction, clear and open channels of communication are essential. To maintain communications throughout construction, specific meetings will be held. These meetings are detailed in the following subsections.

2.3.1 Preconstruction Meeting

Prior to commencing construction of each major phase at the CTWMA, a preconstruction meeting shall be held. This meeting will include the parties involved in the construction, including the Project Manager, Construction Manager, Design Engineer, Installation Contractor, and the Quality Assurance Engineer.

The purpose of this meeting is to establish lines of communication, review construction plans and specifications, emphasize the critical aspects of a project necessary to ensure proper quality, begin planning and coordination of tasks, anticipate any problems that might cause difficulties or delays in construction, and above all, to present the CQA Program to all parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by each party to this Program.

Specific topics considered for this meeting include the following:

- Review critical design of the project, including the plans and CQA Program;

- Make appropriate modifications to the CQA Program and develop any task-specific addenda;
- Review the responsibilities of each party;
- Review lines of authority and communication;
- Review methods for documenting and reporting and for distributing documents and reports;
- Discuss corrective actions to resolve potential construction problems;
- Review the number and locations of the testing requirements;
- Review precautions to be taken to maximize bonding between lifts of compacted low permeability soil;
- Review precautions to be taken to minimize desiccation cracking of low permeability soil surfaces;
- Review methods of low permeability soil layer surface preparation and approval prior to cover soil placement;
- Review the construction work plan developed by the installation contractor;
- Review the time schedule for all operations;
- Observe the site survey benchmarks locations and review methods for maintaining vertical and horizontal control;
- Review documentation requirements;
- Review the survey documentation tables and plans which identify the locations where survey documentation information is required;
- Review repair procedures; and
- Discuss health and safety issues associated with cap installation.

The meeting will be documented by a person at the beginning of the meeting and minutes shall be transmitted to all parties.

2.3.2 Progress Meetings

Progress meetings will be held as needed (daily, weekly, etc.) at the work area. At a minimum, the meeting should be attended by the Construction Manager, Superintendent, and the Quality Assurance Engineer. The purpose of the meeting is as follows:

- Review the planned work activities and locations;
- Discuss the Installation Contractor's personnel and equipment assignments for the week;
- Review the previous week's activities and accomplishments;
- Review the work schedule;
- Discuss possible problems;
- Review any new test data; and
- Review data documentation requirements.

3.0 ORGANIZATION AND DOCUMENTATION REQUIREMENTS

3.1 ORGANIZATION OF CQA PROGRAM PARTIES

Overall responsibility for carrying out the provisions of this CQA Program is with the Construction Manager and Quality Assurance Engineer. The Quality Assurance Engineer is responsible for documenting, pursuant to this CQA Program, that construction at the CTWMA is consistent with the approved CTWMA design and this CQA plan. This documentation will also include the submittal of reports and other documents detailed throughout this CQA Program to ARCO on a timely basis, in addition to any other responsibilities described in this document.

The Laboratory is responsible for ensuring that all test data and reports completed by the Soils Testing Laboratory are submitted directly to the Quality Assurance Engineer. It is the responsibility of the Quality Assurance Engineer to resolve any disputes between the Laboratory and Installation Contractor.

The Installation Contractor (including any subcontractors that may be brought to the site) will report to ARCO's Construction Manager for matters relating to the CQA Program. The overall construction organization for this CQA plan is shown on Figure 2-1.

3.2 DAILY CONSTRUCTION REPORTS

The Quality Assurance Engineer will complete a daily summary report of each day's construction activities. Each construction report will contain, at a minimum, the following information:

- Date, project name, location and report preparer's name;
- The number and name of people on-site under the direction of the preparer for conducting CQA tasks;
- Time work starts and ends each construction work day. This information should also include any work stoppages due to inclement weather or insufficient equipment or personnel;
- Summaries of any meetings held and actions recommended or taken;
- Data on weather conditions including temperature, wind direction and speed, cloud cover, and any precipitation events;
- Installation Contractor's work force, type of equipment in use, weight of compactor, and materials delivered to or removed from the job site;
- Chronological description of work in progress including any notices to or requests from the Installation Contractor;
- Results (or a clear reference to where the results can be found) of testing performed on-site by personnel under the direction of the Quality Assurance Engineer or his representative;
- Problem/deficiency identification and corrective action section to document field problems and non-conforming materials or work as discussed in Subsection 3.2.1;
- Samples which were collected, marked, and sent to the Soils Testing Laboratory. These will be clearly indicated in the daily report by direct inclusion or by reference to the document containing such information. Likewise, reference should be included for any test data submitted by the Soils Testing Laboratory;
- An accurate record of observations that were made, and descriptions of the adequacy of the work that was performed;
- An accurate record of communications with other CQA Program parties, or any other outside companies, regulatory agencies, or consultants regarding the day's construction activities; and

- An accurate record of calibrations or standardizations performed on field testing equipment, including actions taken as a result of recalibrations. In addition, the results of other data recording will be kept in the daily log or will be adequately cross-referenced for each location.

To provide consistency, the Quality Assurance Engineer should use documentation forms. Example forms for daily construction reports, field moisture and density testing, material sampling logs, photograph logs, and nuclear density gauge calibration logs are included in Appendix A.

3.3 PROBLEM/DEFICIENCY IDENTIFICATION AND CORRECTIVE ACTION

Problem and/or deficiency identification and corrective actions will be documented in the Daily Construction Reports by the Quality Assurance Engineer when any construction material or activity is observed or tested that does not meet the requirements set forth in this plan. The documentation reports should be cross-referenced to the applicable forms, data sheets, checklists, and other reports that contain data or observations leading to the determination of a problem or deficiency. Problems/deficiency identification and corrective action documentation may include the following information:

- A description of the problem or deficiency, including reference to any supplemental data or observations responsible for determining the problem or deficiency;

- Location of the problem or deficiency;
- An opinion as to the probable cause of the problem or deficiency; and
- A recommended corrective action for resolving the problem or deficiency. If the corrective action has already been implemented, the observations and documentation to show that the problem or deficiency has been resolved should be included. If the problem or deficiency has not been resolved by the end of the day upon which it was discovered, then the report will clearly state that it is an unresolved problem or deficiency. If the problem or deficiency has not been resolved, the Quality Assurance Engineer and Construction Manager will discuss the necessary corrective actions to resolve the problem or deficiency as soon as possible.

The Construction Manager, working with the Quality Assurance Engineer, will determine if the problem or deficiency is an indication of a situation that might require changes to the plans and/or the CQA Program. If this situation develops, then a meeting will be held with the appropriate parties to determine if revisions to the plans or CQA Program should be made. Any revisions to the plans or the CQA Program must be approved by the Construction Manager, Quality Assurance Engineer, and, if appropriate, the regulatory agencies.

3.4 DRAWINGS OF RECORD

Drawings of record (also called "as-built" drawings) will be prepared by ARCO or its representatives to document the actual lines, grades, and conditions of the CTWMA upon completion. For soil components, the record drawings shall include survey data that show bottom and top elevations of a particular component and the plan dimensions of the component.

3.5 PHOTOGRAPHIC DOCUMENTATION

Photographs will be taken to document observations, problems, deficiencies, and work in progress. Photographs will be in color slide or print format and will be filed in chronological order in a protective file. A photograph log shall be maintained by the Quality Assurance Engineer. An example log form is included in Appendix A.

3.6 CONSTRUCTION DOCUMENTATION REPORTS

The Quality Assurance Engineer shall assemble one Construction Documentation Report for the entire construction project by combining the data and reports generated by the Quality Assurance Engineer. This report will be issued separately and as an appendix to the LAO Phase II final construction report.

At a minimum, the Construction Documentation Report will contain the following information:

- Documentation (as-built) set of drawings representing actual installation of each material as it relates to the plan views and individual details;
- Any written correspondence with the MDEQ;
- Summary of any problems and/or deficiencies encountered and their resolution during construction, including any recurring problems or deficiencies that were discovered;
- Documentation that acceptance criteria were met, including comparison of procedure data with construction plans and specifications and requirements set forth in the CQA Program;
- Quality assurance test results; and
- Certification by the Quality Assurance Engineer that the construction meets the requirements of the approved plans and this CQA Program.

4.0 MATERIALS

The CTWMA cap will consist of multiple layers of earthen materials over excavated mine wastes and associated soils from the LAO. These fill materials will consist of, from top to bottom:

- a 6-inch layer of growth media/seed bed layer;
- a 12-inch layer of cover soil;
- a 6-inch layer of granular material serving as a capillary break/drainage layer;
- an 18-inch layer of fine-grained materials serving as an infiltration barrier; and
- a 6-inch layer of mine wastes and associated soils from the LAO compacted to 95% of its Standard Proctor density serving as the prepared cap subgrade.

This cap is design to meet the requirements of the preferred alternative for the CTWMA identified in the *Butte Silver Bow Landfill/Clark Tailings Corrective Measures Assessment* (Pioneer, 1996b).

4.1 CTWMA SUBGRADE PREPARATION

The cap subgrade shall be properly prepared in order to provide adequate support for compaction and be free from mass movements. The subgrade will be composed of excavated materials (Type J Fill in the Technical Specifications) from LAO. This material shall be free of debris and deleterious or objectionable materials. The material after compaction will have no extruding rocks or sticks that may effect the integrity of the overlying infiltration barrier layer.

4.2 INFILTRATION BARRIER LAYER

Generally fine-grained materials (Type K or L fill) will be removed from LAO or from a nearby borrow source and placed as the infiltration barrier layer above the prepared subgrade in the CTWMA cap. The materials shall be native silts, clayey silts, or clayey/silty sands. The material shall be approved by ARCO and shall meet the following gradation criteria, defined in the Technical Specifications.

Prior to acceptance of materials for use for the low permeability infiltration barrier, the Quality Assurance Engineer will visit the location where the material is being acquired to visually observe and field classify the material. Two sources of Type K or L (infiltration barrier) materials have been identified and tested by the Operator and the Design Engineer: the native silts (ML) and organic clays (OH) from the LAO and sandy clays (SC) from the Hollow pit north of the Clark Tailings. The native materials from LAO, if used for the infiltration barrier layer, shall be separated from other materials (such as tailings) to the extent feasible using standard excavating procedures and equipment during removal from LAO. While no mechanical separation or screening shall be required, materials should be excavated, loaded, and transported to the CTWMA separately from waste materials.

Prequalification samples of both the materials from LAO and the materials from the Hollow pit were analyzed for natural moisture content, grain size distribution, Atterberg limits, moisture-density relationship, and hydraulic conductivity. The testing showed that these materials satisfy the Technical Specifications; in situ testing of these materials show that they consistently achieve hydraulic conductivities of less than 1.0E-06 cm/sec. A report on the prequalification testing, including the test pad construction, is included in Appendix B.

Any alternative materials proposed for the low permeability soil used for the infiltration barrier shall have a classification of SC, fat clays (CH), lean clays (CL), ML, or OH in accordance with ASTM D 2487, and an in-place compacted saturated hydraulic conductivity equal to or less than 1.0E-05 cm/sec within the density and moisture content range identified in the Technical Specifications. Alternative materials will be subjected to prequalification testing at the discretion of the Quality Assurance Engineer for the parameters listed in Table 4-1 prior to acceptance.

TABLE 4-1
PREQUALIFICATION TESTING REQUIREMENTS FOR ALTERNATIVE INFILTRATION BARRIER MATERIALS

PARAMETER	ASTM TEST METHOD
Water Content	D 2216 D 4643 D 4944 D 4954
Atterberg Limits	D 4318
Sieve Analysis	D 422 (gravel) D 1140 (fines)
Standard Proctor	D 698
Recompacted Hydraulic Conductivity	D 5084

The proposed materials may also be subjected to in situ hydraulic conductivity testing. This testing should be conducted in accordance with the two-stage borehole (Boutwell and Tsai, 1992) or sealed-double ring infiltrometer (ASTM D 5093) methods.

4.3 CAPILLARY BREAK

Imported granular material (Type M Fill) from rock pits near Centerville will be placed as the capillary break material over the infiltration barrier layer. This material shall be free from debris and deleterious or objectionable materials and shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/4-inch	10-30
#200	0-10

Note: The 3-inch particle size is defined as material capable of passing a 3-inch screen.

4.4 COVER SOIL

Imported clean backfill (Type C Fill) will be placed on top of the capillary layer at a depth of 12 inches. This material shall be free from debris and deleterious or objectionable materials and shall meet the following gradation criteria:

Particle Size	% Finer Than
6-inch average diameter	100
#200	5-20

Likely sources of Type C materials are the Hollow pit located north of the site or ARCO-owned borrow sources west of LAO.

4.5 GROWTH MEDIA

Imported soil (Type G Growth Media) will be placed at a 6-inch depth over the cover soil in the CTWMA. The material shall be free from debris, rocks, roots, and deleterious or objectionable materials. This material shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/8-inch	85-100
#4	50-90
#40	20-50
#200	10-40

Likely sources of Type G Growth Media materials are the Hollow pit located north of the site or ARCO-owned borrow sources west of LAO.

4.6 GEOSYNTHETIC CLAY LINER

A geosynthetic clay liner (GCL) will be used to line the sedimentation basin south of the Clark Tailings, as shown on the Drawings. The material shall be Bentomat ST, as manufactured by CETCO, or approved equivalent as described in the Technical Specifications.

Prior to installation, the Quality Assurance Engineer will review the Quality Assurance document provided by the manufacturer of the GCL. This document should describe the

manufacturer's program and procedures for assuring the raw materials (particularly the sodium bentonite) used in the GCL meets the manufacturer's specifications and the final product meets the manufacturer's specifications. The manufacturer shall certify that the materials meet the manufacturer's standard specifications. The Quality Assurance Engineer will review the manufacturer's standard specifications and verify that they comply with the Technical Specifications. The Quality Assurance Engineer shall also verify that the manufacturer has certified that the GCL has been inspected for the presence of broken needles.

5.0 EARTHWORK

5.1 PLACEMENT OF LAO FILL MATERIALS

Materials excavated from LAO (Type H Fill and Type I Fill as defined in the Technical Specifications) and transported to the site will be placed to the lines and grades shown on the Drawings in accordance with the specifications. The Quality Assurance Engineer will oversee the placement of the materials to monitor compliance with the specifications. This will include period measurements of moisture-density relationships and compacted densities and moisture contents.

The materials will be compacted from 90% to 95% of their maximum dry density (as determined via ASTM D 698), as defined in the specifications, at -2 to +2 percent of optimum moisture content. The Quality Assurance Engineer will have moisture-density relationship analyses conducted as material conditions warrant. The Quality Assurance Engineer will perform in-place tests to determine density and moisture of the compacted materials (via ASTM D 2922 and D 3017) to measure compliance with the specifications. The Quality Assurance Engineer shall perform moisture and density tests at a minimum frequency of three tests per acre per lift (or one test per each 500 cubic yards based on 12-inch lifts). If the Quality Assurance Engineer determines that the materials do not satisfy the specifications, he will define the area not in compliance (via additional testing) and that area will be repaired by the Installation Contractor. The Quality Assurance Engineer will retest repaired areas before approval.

5.2 SUBGRADE PREPARATION

The Installation Contractor will be responsible for preparing the subgrade for construction of overlying components according to the subgrade compaction specifications. Requirements for the preparation, placement, and compaction of Type J Fill include:

- Maintain positive surface drainage to avoid ponding of water on fill.
- The surfaces upon or against which Type J Fill will be placed, including previously placed and compacted layers, shall be clean of all objectionable materials, shall be moist but free of standing or ponded water, and shall be scarified as necessary, to provide a suitable bond between the existing and newly placed material.

- The uppermost 6 inches (compacted) of Type J Fill shall be placed in one lift over the portion of the CTWMA impacted by the placement of LAO materials to the line and grade as shown on the Drawings or as directed by ARCO.

- Materials containing less than 5% by dry weight of particles passing a #200 screen shall be compacted to a minimum of 90% of the maximum index density as determined by ASTM D 4253.

- Materials containing greater than 12% by dry weight of particles passing a #200 screen shall be compacted to a minimum of 95% of the maximum index density as determined by ASTM D 698.

- Materials containing 5% to 12% by dry weight of particles passing a #200 screen shall be compacted in accordance with the requirements of 5 or 6 above at the discretion of ARCO.

- In-place density tests on the subgrade material (Type J Fill) will be performed by the Quality Assurance Engineer or his representative with a nuclear density gauge in accordance with ASTM D 2922. Care will be taken to ensure the appropriate Proctor curve is used for comparing the results.

5.3 INFILTRATION BARRIER LAYER

5.3.1 Test Pads

Test pads were constructed in accordance with EPA guidance contained in *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA, 1993). A report on test pad construction and testing results is included in Appendix B.

5.3.2 Material Properties

The low permeability infiltration barrier materials shall meet the requirements as outlined in Section 4.2. During construction of the low permeability infiltration barrier layer, the Quality Assurance Engineer will obtain samples of on-site infiltration barrier material just before compaction. Sample material will be obtained on a more frequent basis when, in the judgement of the Quality Assurance Engineer, the low permeability infiltration barrier material has changed.

Samples will be periodically collected to confirm the properties of the infiltration barrier material. Table 5-1 summarizes minimum tests and testing frequencies of the infiltration barrier materials during the construction phase. Samples may be collected from the borrow source during material production, from stockpiles at the borrow source or the site, or from loose lifts placed as infiltration barrier materials. If statistical analysis of testing results shows the material being used for the infiltration barrier layer is relatively homogenous (i.e., there is little deviation

from sample to sample), the frequency of testing may be reduced. The Quality Assurance Engineer, the Construction Manager, and the Project Manager shall meet to determine if the frequency of testing may be reduced.

TABLE 5-1
MATERIALS TESTS FOR INFILTRATION BARRIER MATERIALS

PARAMETER	TEST METHOD	MINIMUM TESTING FREQUENCY
Percent Fines (Note 1)	ASTM D 1140	1 per 1,050 cu. yd. (Note 2)
Percent Gravel (Note 3)	ASTM D 422	1 per 1,050 cu. yd. (Note 2)
Atterberg Limits	ASTM D 4318	1 per 1,050 cu. yd. (Note 2)
Standard Proctor	ASTM D 698	1 per 5,300
Construction Oversight	Observation	Continuous

Notes:
1. Percent fines is defined as percent passing the #200 sieve.
2. In addition, at least one test should be performed each day that soil is placed, and additional tests should be performed on any suspect material observed by CQA personnel.
3. Percent gravel is defined as percent retained on the #4 sieve.

Occasional deviations from construction specifications are acceptable as described in Table 5-2. Table 5-2 presents the maximum allowable frequency of deviations from the specifications during the placement and construction of the low permeability infiltration barrier layer.

TABLE 5-2
MAXIMUM ALLOWABLE VARIATIONS

PARAMETER	MAXIMUM ALLOWABLE PERCENTAGE OF OUTLIERS
Atterberg Limits	5% of samples may fall outside specification and outliers not concentrated in one lift or one area
Grain Size	5% of samples may fall outside specification and outliers not concentrated in one lift or one area

5.3.3 Construction

The soil materials comprising the infiltration barrier of the soil cap may need to be processed prior to use. The principal preprocessing steps that must be required include the following:

- Drying of soil that is too wet;
- Wetting of soil that is too dry;
- Removal of oversized particles;
- Pulverization of clods of soil; and
- Homogenization of nonuniform soil.

Tests are performed to confirm proper preprocessing, but visual observations by the Quality Assurance Engineer are also needed to confirm that proper procedures have been followed and that the infiltration barrier material has been properly processed.

All surfaces upon which infiltration barrier materials will be placed shall be free of all objectionable materials, as visually determined by ARCO, in accordance with the Technical Specifications (Section 02110- Site Clearing). Surfaces shall be free of standing water and shall be scarified as necessary so as to provide a suitable bond between the underlying materials and the infiltration barrier materials, particularly on side slopes.

The low permeability infiltration barrier materials shall not be frozen when placed, and shall not be placed on ice or frozen material. This material shall be placed in loose thickness lifts not to exceed nine inches loose thickness or six inches compacted thickness according to the same procedures as developed during the test pad program and, at a minimum, the following requirements:

- All lifts shall be compacted to the minimum density in the Technical Specifications to achieve a maximum hydraulic conductivity of 1.0E-05 cm/sec.

- The moisture content, as determined by ASTM D 2216, shall be between 0 to + 4% of the optimum moisture content as determined by ASTM D 698 and shall be uniform throughout the lift. Placed materials not meeting this requirement, as determined by testing by the Quality Assurance Engineer, shall be scarified to the depth of the lift in question, wetted or dried as necessary to meet this requirement, and mixed to a uniform water content throughout the entire depth.

- Hand manipulated compaction equipment (vibrating drums or mechanical tampers) shall be used for working in confined areas and adjacent to structures.

- The daily work area should extend to such a distance necessary to minimize desiccation and crusting of the lift surface. The finished surface may be smooth rolled at the end of the day to promote precipitation run-off as necessary.

If desiccation, crusting, or sealing by rolling of the lift surface occurs prior to placement of the next lift, the area shall be scarified to a minimum depth of one inch or until sufficiently moist materials are encountered, whichever is greater. After scarification, the surficial infiltration barrier materials should be removed to obtain a moisture content at least two percent above optimum moisture content. Alternatively, the drier surficial materials may be stripped and mixed with moist materials to achieve a uniform moisture content satisfying the project requirements. Also, the addition of water to surfaces prior to placement of additional infiltration barrier materials may be utilized when necessary to maintain uniformly moist soil conditions.

The finished grade shall be within ± 0.3 foot of line and 0.1% of grade as shown on the Drawings or as directed by ARCO, and a positive surface drainage shall be maintained to minimize ponding of water on the fill.

5.3.4 Compaction Control

Testing is required to control the moisture content and density of the low permeability infiltration barrier materials. The Quality Assurance Engineer will:

- Conduct in-place density and moisture content tests (via ASTM D 2922 and ASTM D 3017, respectively) at a minimum frequency of five tests per acre lift of soil (or one test per 160 cubic yards of soil, based on 6-inch lifts);
- Conduct a direct oven moisture content test (ASTM D 2216) or a nuclear moisture test with a different gauge for every ten nuclear moisture content tests (ASTM D-3017);
- Conduct a sand cone test (ASTM D 1556) or another nuclear density test with a different gauge for every 20 nuclear density tests (ASTM D 2922); and
- Ensure that all test penetrations in the low permeability infiltration barrier are filled with bentonite pellets (by the QA Monitor conducting the tests) prior to placement of the next lift.

5.3.4.1 Sampling patterns

Sample locations during testing may be selected via two methods:

- The first method in selecting sampling points is by using the grid system established by Quality Assurance Engineer. The grid system will define a grid for locating samples, and the Quality Assurance Engineer will ensure that the grid patterns are staggered over successive lifts in accordance with EPA guidelines.
- The second method in selecting sampling points is by using the random selection method established by the Quality Assurance Engineer (based on a random number generated that

corresponds to a location on the lift) with no sampling points located within two meters of another sampling point in accordance with EPA guidelines.

5.3.4.2 Allowable variations and outliers

Failing results for field water content or density tests may be a result of several factors including:

- Human error in measurement of water content or dry unit weight;
- Natural variability of the soil or the compaction process leading to an anomaly at an isolated location;
- Limitations in the sensitivity and repeatability of the test methods; or
- Inadequate construction procedures that reflect broader-scale deficiencies.

If it is suspected that a test result is in error, the CQA personnel should return to the point where the questionable measurement was obtained. Several additional tests should be performed in close proximity to the questionable test. If three of the repeat tests provide satisfactory results, the questionable test result may be disregarded as an error.

A few randomly located test failures are acceptable, as the quality and integrity of the infiltration barrier layer will not be compromised. Table 5-3 specifies the maximum percentage of failing compaction tests allowable under the CQA plan.

TABLE 5-3
MAXIMUM PERCENTAGE OF FAILING COMPACTION TESTS

PARAMETER	MAXIMUM ALLOWABLE PERCENTAGE OF OUTLIERS
Water Content	3% and outliers not concentrated in one lift or one area, and no water content test value less than 2% or more than 3% of the allowable value
Dry Density	3% and outliers not concentrated in one lift or one area, and no dry density test value less than 0.8 kn/m^3 (5pcf) below the required value

5.3.4.3 Corrective actions

If it is determined that an area does not conform with specifications and needs to be repaired, the extent of the area requiring repair will be defined by the Quality Assurance Engineer through additional testing around the failed area. Additional tests will be performed until the failing area is bracketed by tests passing the specifications. In this way, the failing area can be properly defined and repaired. The Installation Contractor will repair the failing area defined by the Quality Assurance Engineer.

5.3.5 Protection of Work

During construction, the low permeability infiltration barrier should be protected from detrimental climatic effects by incorporating the following procedures:

- No frozen low permeability infiltration barrier material shall be placed.
- Low permeability infiltration barrier material shall not be placed on a previous lift of low permeability material which is frozen. Frozen in-place low permeability infiltration barrier material shall be removed prior to placement of additional low permeability infiltration barrier material.
- Low permeability infiltration barrier material which has been subjected to a freeze/thaw cycle(s) shall be scarified and/or disked prior to recompaction and prior to placement of subsequent lifts of low permeability infiltration barrier material.
- Exposed finished lifts of infiltration barrier material should be sprinkled with water daily to minimize desiccation, as necessary.
- At the end of each day's construction activities, completed lifts or sections of compacted low permeability infiltration barrier material may be sealed by rolling with a rubber tire or smooth-drum roller or by backdragging with a bulldozer, and should be sprinkled with water, as needed.
- Proper grading should be provided at the end of each workday to assure adequate run-off in the event of overnight rain.

5.4 CAPILLARY BREAK

Capillary break materials (Type M Fill) shall be transported and placed in one lift of 3 inches so as to minimize the migration of fine-sized particles into void spaces. This material shall not be pushed more than 100 feet nor end dumped higher than 10 feet to maintain proper size distribution. The finished grade shall be compacted sufficiently to support traffic by construction equipment, within ± 0.3 foot of line and 0.1% of grade as shown on the Drawings or as directed

by ARCO. Gradation data for this material will be provided by the supplier. Testing frequency for the gradation, via ASTM D 422, will consist of 1 test per 10,000 cubic yards to monitor compliance with the specifications. Additional tests may be conducted at the discretion of the Quality Assurance Engineer.

5.5 COVER SOIL

Cover soil (Type C Fill) shall be placed as loosely as possible to promote vegetative growth in lifts not to exceed 12 inches. The material shall not be frozen when placed and not be placed on ice or frozen material. Finish grading the cover soil to within ± 0.3 foot of line and 0.1% of grade as shown on the Drawings or as directed by ARCO. Maintain positive surface drainage to minimize ponding of water on the fill. Testing frequency for the gradation, via ASTM D 422, will consist of 1 test per 10,000 cubic yards to monitor compliance with the specifications. Additional tests may be conducted at the discretion of the Quality Assurance Engineer.

5.6 GROWTH MEDIA

Growth media (Type G media) shall be placed as loosely as possible in lifts not to exceed six inches to promote vegetative growth. Best management practices (BMPs) shall be employed to minimize erosion until vegetation is established. The material shall not be frozen when placed and not be placed on ice or frozen material. Finish grading the growth media to within ± 0.3 foot of line and 0.1% of grade as shown on the Drawings or as directed by ARCO. Maintain positive surface drainage to minimize ponding of water on the fill. Testing frequency for the gradation, via ASTM D 422, will consist of 1 test per 10,000 cubic yards to monitor compliance with the specifications. Additional tests may be conducted at the discretion of the Quality Assurance Engineer.

5.7 GEOSYNTHETIC CLAY LINER

Upon delivery of the GCL to the site, the Quality Assurance Engineer will document the manufacturer, the lot numbers, and the roll numbers of the materials delivered to the site. The materials shall be stored covered and off the ground in accordance with the manufacturer's recommendations and the Technical Specifications. The Quality Assurance Engineer will review the Installation Contractor's submittals and determine if the materials satisfy the Technical Specifications.

Prior to installation, at the discretion of the Quality Assurance Engineer, conformance samples of the GCL may be collected and submitted to an independent laboratory for analysis. These samples should be collected in conformance with ASTM D 4354, Sampling of Geosynthetics for Testing. The samples may be analyzed for mass per unit area (ASTM D 5261) and the free swell of clay component (GRI-GCL1). The samples may also be analyzed for other performance-oriented parameters (these are typically performed at less frequent intervals) including hydraulic

conductivity (ASTM D 5084), direct shear (ASTM D 5321), and peel testing (ASTM D 413). The Quality Assurance Engineer will determine if the test results comply with ASTM D 4759.

Prior to installation, the Quality Assurance Engineer will approve the prepared subgrade. The subgrade shall be free of vegetation, debris, sticks, sharp rocks, void spaces, ice, abrupt elevation changes, standing water, cracks larger than 0.25-inch, and any other materials or conditions that may damage the GCL. The subgrade shall have no protrusions extending more than 0.5-inch from the surface.

The Quality Assurance Engineer will monitor the installation of the GCL to check conformance with the manufacturer's guidelines for installation and the Technical Specifications. The Quality Assurance Engineer will monitor the following:

- Equipment used to deploy the GCL does not compromise the integrity of the subgrade.
- The minimum overlap on the seams shall be six inches.
- A minimum of 0.25 pounds of granular bentonite shall be applied to all seams.
- All seams on slopes greater than 4H:1V are oriented parallel to the slope.
- All materials are anchored in an anchor trench in accordance with the drawings and specifications.
- All tears, holes, and rips in the GCL (or its component geotextiles) are repaired in accordance with the manufacturer's recommendations and the Technical Specifications. If the damage involves the clay portion of the GCL, the repair shall consist of overlapping the damaged area with a full GCL patch.
- All patches used for repairs shall extend at least 12 inches beyond the damaged area in all directions.
- GCL patches will be seamed with granular bentonite applied a minimum rate of 0.25 pounds per lineal foot.

After deployment and seaming of the GCL, cover soil will be placed as shown on the Drawings. Before covering the GCL, it must be approved by the Quality Assurance Engineer. During any working day, only as much GCL should be deployed as can be seamed and covered in that day, particularly if there is a threat of inclement weather. GCL should not be deployed during precipitation events that may lead to premature hydration of the clays. During placement of cover soil, the Quality Assurance Engineer will monitor type and depth of cover soil placed over the GCL. Cover soil will be placed according the following guidelines (in accordance with the specifications and the manufacturer's regulations):

- Soil placement will not damage the GCL or underlying materials.
- A minimum of 12-inches of soil shall be maintained between the GCL and the tires or tracks of equipment used to spread and place the soil. For any high-traffic areas, a minimum of 24-inches of soils shall be maintained between the GCL and the tires or tracks.

- Soil shall be placed in such a way as to prevent soil particles from entering the GCL overlap zones (seams). Where possible, the backfilling will proceed in the direction of downgradient shingling.
- Soil shall be placed so that no excess tensile stress is mobilized in the GCL. This will require backfilling on side slopes to proceed from the bottom of the slope upward.

6.0 REFERENCES

American Society for Testing and Materials (ASTM), 1916 Race St., Philadelphia, PA, Standard Test Methods:

ASTM D 413, "Rubber Property-Adhesion to Flexible Substrate";
ASTM D 422, "Particle Size Analysis";
ASTM D 698, "Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 5.5-lb (2.48 kg) Rammer and 12-in (305 mm) drop";
ASTM D 854, "Specific Gravity of Soils";
ASTM D 1140, "Amount of Material Finer than the No. 200 Sieve";
ASTM D 2216, "Laboratory Determination of Water (Moisture) Content of Soil and Rock";
ASTM D 2922, "Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)";
ASTM D 3107, "Water Content of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)";
ASTM D 4318, "Liquid Limit, Plastic Limit, and Plasticity Index of Soils";
ASTM D 4759, "Determining the Specification Conformance of Geosynthetics";
ASTM D 5084, "Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter";
ASTM D 5093, "Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed Inner Ring"; and
ASTM D 5261, "Measuring Mass per Unit Area of Geotextiles".

Boutwell, G.P., and Tsai, C.N., 1992. "The Two-Stage Field Permeability Test for Clay Liners," *Geotechnical News*, Vol. 10, No.2, pp. 32-34.

EPA, 1993. *Technical Guidance Document: Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93/182, U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C., September 1993.

GRI-GCL1, "Free Swell Conformance Test of Clay Component of a GCL," Geosynthetics Research Institute, Drexel University, Philadelphia, Pennsylvania.

Pioneer Technical Services, 1996a. *Lower Area One (LAO)/Clark Tailings Disposal Area Phase I, Segment II LAO Expedited Response Action Technical Specifications*, Prepared for Atlantic Richfield Company, Anaconda, Montana, August 1996.

Pioneer Technical Services, 1996b. *Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment, Second Draft*, prepared for Butte-Silver Bow Department of Public Works, Butte, Montana, December 1996.

APPENDIX A

EXAMPLE FORMS

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

DAILY FIELD REPORT

Page ___ of ___

DATE/TIME: ______________________

DAY: S ___ M ___ T ___ W ___ TH ___ F ___ S ___

WEATHER: Brite Sun ___ Clear ___ Overcast ___ Rain ___ Snow ___

TEMP.: To 32 ___ 32-50 ___ 50-70 ___ 70-85 ___ 85 up ___

WIND: Still ___ Moder. ___ High ___

HUMIDITY: Dry ___ Moder. ___ Humid ___

PROJECT ______________________

JOB NO. ______________________

CLIENT ______________________

CONTRACTOR ______________________

PROJECT MANAGER ______________________

FIELD ACTIVITIES:

BY ______________________ TITLE ______________________

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

DAILY FIELD REPORT (cont'd.)

Page ___ of ___

DATE/TIME: ____________

PROJECT____________

JOB NO. ____________

FIELD ACTIVITIES (cont'd.):

BY____________ TITLE____________

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

FIELD DENSITY TEST SUMMARY

Project
Project No.
Tests on
Page ___ of ___

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services
PO Box 3445
Butte, MT 59702
(406) 782-5177

NUCLEAR DENSITY GAUGE
STANDARD COUNT LOG

GAUGE ____________________

DATE	OPERATOR	LOCATION	DENSITY COUNT	MOISTURE COUNT

PO Box 3445
Butte, MT 59702
(406) 782-5177

FIELD SOIL SAMPLING LOG FORM

Project Name____ Project # _____________

PIONEER ID#	CLIENT ID#	DATE	SAMPLED BY	SAMPLE TYPE	LOCATION	ANALYSES

PHOTO LOG

ROLL NO.	PHOTO NO.	DESCRIPTION

APPENDIX B

TEST PAD CONSTRUCTION AND RESULTS

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

MEMORANDUM

DATE: August 7, 1996

TO: Eric Jacobsen, ARCO

FROM: Brad Archibald, P.E. BCA

RE: LAO Test Pads Construction and In Situ Permeability Testing Report

Test pads of the possible infiltration barrier materials for the Clark Tailings were constructed at Lower Area One (LAO) in Butte on July 1 to July 3 and July 9. This memo summarizes the construction activities and testing results. Daily reports are included in Appendix A.

Initially three test pads were planned: one consisting of 50% LAO clay/silt and 50% silty/clayey sand from Hollow's pit; one consisting of 75% LAO clay/silt and 25% of decomposed granite from Hollow's pit; and one consisting of 100% silty/clayey sand from Hollow's pit. Ultimately, four pads were constructed, as follows:

CTTP1:	50% LAO clay/silt mixed with 50% Hollow silty/clayey sand
CTTP2:	50% LAO clay/silt mixed with 50% decomposed granite from Hollow's pit
CTTP4:	100% Hollow silty/clayey sand
CTTP5:	100% LAO clay/silt

Test Pad CTTP3 was not constructed because of difficulties compacting overly wet tailings as a base.

Weather during test pad construction was generally dry and very warm. Highs generally reached the 80s to low-90s; there was just a trace of precipitation on the afternoon of July 3.

SAMPLING METHODOLOGY

Prior to construction of the test pads, permeability testing of selected materials that were being considered as possible infiltration barrier layers at that time was completed (via ASTM D5084, Method C). The materials tested included the native clayey sands from Hollow's pit; a mixture of

100% post-consumer paper & 100% vegetable based inks

LAO tailings and the native clay/silt from below the LAO tailings; and the native clay/silt from LAO by itself. These data, included in Appendix G, indicated that the materials being considered could meet the regulatory vertical permeability requirement of 1.0E-05 cm/sec.

After the laboratory permeability testing was completed, the list of potential infiltration barrier layer materials was refined slightly. No additional laboratory permeability testing was conducted, however. It was felt that the data from the original testing was indicative of the ability of the proposed materials to meet the permeability requirements.

Prior to construction of the test pads, samples of the subgrade, tailings, and the proposed infiltration barrier materials (including mixtures) were prepared and analyzed for moisture density relationship via ASTM D698 (standard Proctor). These "preconstruction" samples were used to determine if the materials being used to construct the test pads were being installed in accordance with the target specifications. During construction, composite samples of the tailings and the infiltration barrier materials were collected from selected lifts. Sampling frequency was complied with the EPA guidance for constructing test pads contained in *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA/600/R-93/182). These "post-construction" samples were analyzed for standard Proctor density (ASTM D698). Some of these samples were also analyzed for particle size distribution (through the No. 200 sieve, via ASTM C136/C117); Atterberg limits (via ASTM D4318); and moisture content (via ASTM D2216).

During construction of the test pads, the in place density and moisture content of the infiltration barrier materials was measured (via ASTM D2922 and ASTM D3017, respectively) at a typical rate of four tests per lift, which meets the minimum sampling frequency of one test per 400 ft^2 cited in EPA's guidance. To verify the results of the field testing, four samples were collected from a lift of CTTP4 infiltration barrier materials from the locations of field tests. These samples were submitted to the laboratory for moisture content analysis via ASTM D2216. The results, included in Appendix D, showed that the field measurements were very close to the laboratory results, with the nuclear gauge reading an average of 0.4% less moisture content than the laboratory method. Also, sand cone density and moisture results from tests conducted by NTL Engineering and Geoscience (included in Appendix F) during installation of the Boutwell permeameters correlated, in general, very well with the field measurements. The results from the two techniques cannot be correlated directly because the sampling locations were not precisely the same.

SUBGRADE PREPARATION

Prior to construction, an approximately 30'x50' area was leveled for each test pad and the subgrade, a poorly graded sand, was compacted to a minimum of 90% of it's standard Proctor density. This was completed on July 1. Field density test results (1 through 22 from July 1) are included in Appendix B. (Note that on July 1 two nuclear density gauges were used because of concerns about Pioneer's gauge. Based on ensuing standard counts and laboratory verification of moisture readings, only Pioneer's gauge was used after July 1.) The Proctor curve for the subgrade materials is included as Plate P-1 in Appendix C.

TAILINGS PLACEMENT

A 12-inch lift of tailings excavated from LAO was placed directly over the compacted subgrade for each test pad. The purpose of placing the tailings was to assess the effectiveness of the dewatering technique and to mimic as closely as possible the actual capping conditions. Therefore, the intent was to compact the tailings lift to 95% of the maximum dry density at ±2% of the optimum moisture content. Based on the fine fraction observed in the tailings, it was determined in the field on July 2 that they were best represented by preconstruction Proctor curve Plate P-3 (Appendix C). (Additional samples were collected during placement and analyzed by ASTM D698 for standard Proctor density, as described below.)

The tailings under CTTP1 were placed and compacted in one lift on July 2. The lift was compacted with a Caterpillar D6H Low Ground Pressure (LGP) dozer. The lift was approved based on nuclear density tests T22 - T25 on July 2 and Plate P-3. However, it should be noted that a Proctor from a composite sample collected during placement of the tailings lift (Plate P-12, Appendix C) showed that the materials were actually wet of optimum (by 3.4 to 10%, with an average moisture content of 6.5% above optimum) and not in compliance with the ±2% of optimum moisture content specification. Also, based on Plate P-12, the tailings were compacted to an average of 89.1% of the maximum dry density, below the target of 95%. Compaction testing data are summarized on Table 1.

The tailings under CTTP2 were placed in two lifts (one 8-inch compacted lift and one 4-inch compacted lift) on July 2. The tailings were generally wet of optimum moisture (T9, T10, and T12 - T16 from July 2, Appendix B), in some cases beyond the allowable ± 2% identified in the specifications. Field compaction testing data are summarized on Table 2. In the interest of completing the test pads, the tailings lift for test pad 2 was approved. Based on the Proctor curve for a composite sample taken from the tailings during placement (Plate P-11, Appendix C), which showed the tailings were an average of 7.6% above optimum moisture and the average compaction was 88.9% of the maximum dry density.

The tailings under CTTP4 were placed and compacted in one lift on July 2. The lift was compacted with a Caterpillar D6H LGP dozer. The lift was approved based on nuclear density test results T26 - T30 on July 2 (Appendix B). However, the lift was outside the specification of ±2 of optimum moisture content, based on comparison to Plate P-3 (the preconstruction Proctor) and P-10 (from a composite sample taken during placement of the lift). Based on Plate P-10, the average density of the tailings was 89.3% of the maximum dry density, and the average moisture content was 7.6% above optimum. Compaction testing data are summarized on Table 3.

The tailings under CTTP5 were placed on July 2 in one 10- to 12-inch lift, which was compacted with the CAT D6H LGP dozer. The lift was approved on July 3, after drying overnight, based on nuclear density tests T8 - T11 on July 3 (Appendix B). Compaction testing data are summarized on Table 4. No sample was collected during placement of the tailings lift for CTTP5; therefore, the field data are only compared to the preconstruction Proctor (Plate P-3).

Overall, the tailings materials did not meet the target compaction of 95% of the maximum dry density based on the Proctor samples collected during construction of the test pads. The variation between the pre-construction Proctor values and the values for samples collected during construction is due to the heterogeneity of the LAO tailings. Achieving the 95% compaction specification at full-scale will be possible, however. During the test pad construction, the materials were placed well wet of optimum moisture and were compacted with a D6H LGP bulldozer. Utilizing better compaction equipment and/or techniques will result in better compaction of the tailings. For example, during construction of the sedimentation ponds at LAO, berms were constructed of excavated LAO tailings materials. Compaction to 95% of the standard Proctor density was consistently achieved during construction of these berms.

The fact that most of the tailings upon placement were too wet to meet the ±2% of optimum moisture content specification is not necessarily indicative of full-scale activities. Full-scale dewatering may be more effective than the dewatering conducted in the test pits. Also, the tailings used as part of the test pad construction had a large fines fraction; therefore some of the sandier tailings materials present within the LAO excavation area may dewater more easily than these materials did. Nonetheless, it may be necessary to dry the tailings before compacting within the Clark Tailings Combined Waste Management Area to meet the ±2% of optimum moisture content specification.

CTTP1 INFILTRATION BARRIER LAYER

Pad CTTP1 consists of 50% LAO clays mixed with 50% silty sands from Hollow's borrow pit. The materials were mixed with a bucket loader. An attempt was made to mix the materials by wind-rowing and using a grader to mix, but this was not as successful as mixing with the loader. The materials were placed in three approximately 9-inch loose lifts, for a total compacted pad thickness of 1.5 feet ± 0.1 foot. (Vertical control and measurements were provided by Bob Lash of Jordan Contracting, Inc. and verified by Brad Archibald and/or Pat Sampson of Pioneer.) The first lift was applied on July 2 and compacted with the D6H LGP dozer. The material was far over the optimum moisture content (per nuclear density tests T34 - T38 on July 2 and Plate P-6, the preconstruction Proctor). The material was allowed to dry overnight. After compacting the material with the D6H LGP on the morning of July 3 (to repair any desiccation cracking that may have occurred overnight), the lift was tested and approved based on nuclear density tests T2 - T5 on July 3. The material was between 0.5 to 2% above optimum moisture content based on Plate P-6. However, based on Plate P-13, from a sample collected during placement of the lift, the optimum moisture was 3 to 4.5% above optimum moisture. The target for the materials was from 0 to +4% above optimum moisture content. The average compaction of the lift, based on Plate P-13, was 96.2% of the maximum dry density. Compaction testing data are summarized on Table 5. Also, a composite sample collected during placement of this lift was analyzed for particle size distribution and Atterberg limits. These data (included in Appendix E) show that the mixture was a silty sand (SM) with 38.9% fines and a plasticity index of 4.2.

Lift 2 of CTTP1 was placed on July 3. The materials for lift 2 had been mixed on July 2 and were spread and allowed to dry overnight. The 9-inch loose lift was placed and compacted with the D6H LGP dozer. The lift was approved based on nuclear density tests T12 - T15 from July 3. The materials were from 1.9 to 4.2% above optimum moisture, based on Plate P-6. The Proctor curve for a composite sample collected during placement of the lift, Plate P-15, shows that the materials were an average of 2.3% above optimum moisture content. The average density was 95.8% of the maximum dry density. Field compaction testing data are summarized on Table 5. A composite sample of this lift was classified as a clayey sand (SC) with 43.1% fines and a plasticity index of 12.2. The moisture content of the composite sample was 22.1%, comparable to that measured in the field with the nuclear density gauge. Laboratory data are included in Appendix E.

Lift 3 of CTTP1 was also placed on July 3, with the materials and methods used for Lift 2. Four passes of the D6H LGP were used for compaction of the lift. The lift was approved based on nuclear density tests T34 - T37 on July 3. The materials were from 0.5 to 1.5% above optimum moisture content, based on Plate P-6 (data are summarized on Table 5). No sample was collected for laboratory testing during the construction of this lift.

The completed pad was covered with a protective layer of visquene. In situ permeability testing of the test pad was conducted from July 8 through July 14 by NTL Engineering and Geoscience with the assistance of Pioneer personnel. The testing consisted of vertical permeability testing in accordance with the Boutwell procedure cited in EPA's *Quality Assurance and Quality Control for Waste Containment Facilities* (EPA/600/R-93/182). NTL's report on the in situ permeability testing is included as Appendix F. Five Boutwell permeameters were installed on CTTP1. Of the five, two (1-1 and 1-5) drained rapidly. Based on concerns regarding the seals on these two permeameters, they were removed and reinstalled. However, they continued to drain rapidly. The vertical permeability (k_v) in the three remaining permeameters ranged from 7.2E-07 to 2.7E-07 cm/sec. These data indicate that the materials used to construct CTTP1 can satisfy the permeability requirement of 1.0E-05 cm/sec, but that the compaction technique used allowed voids to remain (as evidenced by the two rapidly draining permeameters). Note that sand cone density results conducted by NTL were comparable to the nuclear density gauge testing results reported by Pioneer; however, since the sample locations were not precisely the same, the results cannot be compared directly.

CTTP2 INFILTRATION BARRIER LAYER

CTTP2 was originally to consist of 75% LAO clays and 25% decomposed granite. However, after mixing this material and allowing to dry overnight (July 2 to July 3), the material was still far too wet to work, and this mixture of materials was abandoned. The LAO clays were spread and allowed to dry from July 3 to July 9. On July 9, CTTP2 was constructed of a mixture of 50% LAO clays and 50% decomposed granite from Hollow's pit. These materials were mixed in the same manner as the CTTP1 materials.

CTTP2 was placed in three 9-inch loose lifts. The total thickness of the completed, compacted pad is 1.5 feet ± 0.1 feet. Each lift was placed with the D6H LGP dozer and compacted with four passes of the same dozer.

The first lift was approved based on nuclear density tests T13 - T16 on July 9. The materials were all above 90% of the standard Proctor density, based on Plate P-18 (the preconstruction Proctor). The materials varied from -2.3 to +1.9% of optimum moisture content, also based on Plate P-18. When compared to a Proctor curve from a composite sample collected during placement of the lift (Plate P-21), the materials were compacted to an average of 97% of the maximum dry density at an average moisture content of 1.6% less than optimum, which was outside the target range of 0 to +4% of optimum moisture. Compaction testing data are summarized on Table 6. A composite sample from this lift was analyzed for particle size distribution and Atterberg limits; data are included in Appendix E. The mixture was classified as a silty sand (SM) with 31.9% fines; the plasticity index was 3.0.

The second lift was approved based on nuclear density tests T17 - T22 on July 9. In this lift, moisture varied from -1.1 to +6% of optimum moisture content, based on the preconstruction Proctor (Plate P-18). The average density was 92.9% of the maximum dry density (based on the preconstruction Proctor). Retests near two samples well out of the target of 0 to +4% above optimum moisture content (T17 and T19) showed the materials to be much closer to the target range. No sample from this lift was submitted for laboratory compaction analysis. Testing data are summarized in Table 6.

The third lift was approved based on nuclear density tests T23 - T26. In this lift, moisture contents ranged from -1.3 to +2.3% of optimum moisture, with an average of 0.2% above optimum (when compared to the preconstruction Proctor). The average density was 96.0% of the maximum dry density. No sample from this lift was submitted for laboratory compaction analysis. Testing data are summarized in Table 6.

The completed pad was covered with visquene. In situ vertical permeability testing was commenced on July 18. Five individual Boutwell permeameters were installed on the pad. However, all but one of the permeameters drained rapidly. The permeameters were refilled a number of times, but would not hold water. The one permeameter that did not drain rapidly showed the k_v to be 2.6E-07 cm/sec, which indicates that the material is capable of satisfying the 1.0E-05 cm/sec requirement. However, the rapidly draining permeameters indicate that the compaction technique used on this pad did not provide a uniform infiltration barrier layer. NTL's report on the in situ permeability testing is included in Appendix F.

It should be noted that these materials required water addition during placement to get near the objective of 0 to +4% of optimum moisture content, but this was only after the materials had been spread and dried from July 3 to July 9.

CTTP4 INFILTRATION BARRIER LAYER

CTTP4 was constructed from 100% silty/clayey sand from the Hollow borrow source. The materials were excavated and stockpiled on site on July 2 and 3. The infiltration barrier layer was placed in three 9-inch loose lifts, and the total compacted pad thickness was 1.5 feet ± 0.1 foot. These materials were compacted with an Ingersoll-Rand SP-48 sheepsfoot roller without vibration.

The first lift was placed on July 2. The materials placed were well dry of optimum moisture content, as described in the daily log (Appendix A). After several rounds of ripping and adding water, the moisture was within the target range of 0 to 4% above optimum moisture content (based on the preconstruction Proctors, Plates P-8 and P-9). The first lift was approved in the early afternoon of July 3 based on nuclear density tests T39 - T42, after eight passes with the compactor. The average density was 94.1% of the maximum dry density when compared to the preconstruction Proctors. The moisture content ranged from 2 to 3% above optimum moisture when compared to the preconstruction Proctors, within the target range of 0 to +4% of the optimum moisture content. Field compaction testing data are summarized on Table 7.

The second lift was placed with the D6H LGP dozer with water being added before and during placement. The lift was compacted with four passes of the sheepsfoot roller. It was approved based on nuclear density tests T43 - T46 on July 3, even though two of the four tests were slightly below the target optimum moisture content. Based on the Proctor curve for a composite sample collected during placement of the lift (Plate P-17), the average density was 97.6% of the maximum dry density and the average moisture content was 1.5% below optimum. Field compaction testing data are summarized on Table 7. A composite sample of this lift was classified as a clayey sand (SC) with 33.3% fines. The plasticity index was 7.2 and the moisture content was 13.1%. Laboratory data are included in Appendix E.

The third lift was placed and compacted in the same manner as the second lift. However, more water was added during the placement of the third lift (as determined by qualitative observations). The materials were very near their plastic limit during placement. After compaction (with four passes of the roller), the lift was approved based on nuclear density tests T47 - T50 on July 3. These tests were all within the target moisture content range, based on the preconstruction Proctor. However, when compared to a Proctor curve for a composite sample collected during construction of this lift (P-16), the average moisture content was 0.1% above optimum, but two of the four tests were below the optimum moisture content. The average density was 98.6% of the maximum dry density. Field compaction testing data are summarized on Table 7. A composite sample of this lift was classified as a clayey sand to a silty sand (SC-SM) with 35.1% fines. The plasticity index was 6.9 and the moisture content was 13.2%. Laboratory data are included in Appendix E.

The completed pad was covered with a protective lift of decomposed granite and visquene. In situ permeability testing was conducted by NTL from July 8 to July 15. Five individual Boutwell permeameters were installed on the pad. Originally, one of the permeameters (4-4) drained rapidly. Because of uncertainties regarding the seal, this permeameter was reset. However, after a few days of conducting the in situ permeability testing, a leak in the permeameter was observed by Pioneer personnel conducting the daily monitoring. Therefore, the results from permeameter 4-4 should be disregarded. (It should be noted that k_v measured by this permeameter still met the 1.0E-05 cm/sec requirement even with the leak.) The average k_v in the remaining four permeameters was 2.2E-07 cm/sec. NTL's report on the vertical permeability testing is included in Appendix F.

CTTP 5 INFILTRATION BARRIER LAYER

CTTP5 was constructed of 100% LAO clay/silt. The pad was constructed in three 9-inch loose lifts, and the total thickness is 1.5 feet ± 0.1 foot. Each lift was placed with the D6H LGP dozer and compacted with four passes of the same dozer.

Note that the materials used to construct this pad were spread and allowed to dry from July 3 to July 9. It would not have been possible to construct a pad of these materials within a day after they were excavated from the LAO test pits because of excessive moisture content. However, this is not necessarily indicative of full scale conditions, since full scale dewatering may be more effective than that done to accommodate excavation of the clays for test pad construction.

Lift 1 was approved based on nuclear density tests T1 - T4 on July 9 and the preconstruction Proctor (Plate P-4). Note that some of the materials were wet of the 0 to +4% above optimum moisture content target, even after drying from July 3 to July 9. The density of the materials was 93.0% of the maximum dry density and the average moisture content was 5.2% above optimum. Field compaction testing data are summarized on Table 8.

Lift 2 was approved based on tests T5 - T8 on July 9 and the preconstruction Proctor (Plate P-4). When compared to a Proctor curve for the composite sample collected during placement of this lift (Plate P-20), the materials were at an average density of 96.7% of the maximum dry density and were an average of 1.3% above optimum moisture content. Field compaction testing data are summarized on Table 8. A composite sample of this lift was classified as a silt (ML) with 53% fines. The plasticity index was 3.4. Laboratory data are included in Appendix E.

Lift 3 was approved based on tests T9 - T12 on July 9 and the preconstruction Proctor (Plate P-4). The density of the materials was 97.8% of the maximum dry density and the average moisture content was 2.5% above optimum. Field compaction testing data are summarized on Table 8.

The completed test pad was covered with visquene and a protective layer of decomposed granite. In situ permeability testing was conducted by NTL, with the assistance of Pioneer personnel, from July 18 to July 23. Five individual Boutwell permeameters were installed on the pad. The k_v values ranged from 1.3E-07 cm/sec to 6.8E-07 cm/sec, with an average of 3.0E-07 cm/sec. NTL's report on the in situ permeability testing is included in Appendix F.

TABLE 1. CTTP1 TAILINGS LIFT FIELD COMPACTION DATA.

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP1/T1	JUL2, T22	104.8	17.4	P-3	107.5	17.0	0.975	0.4
(PRECON)	JUL2, T23	104.1	18.9	P-3	107.5	17.0	0.968	1.9
	JUL2, T24	101.9	15.4	P-3	107.5	17.0	0.948	-1.6
	JUL2, T25	102.4	22.1	P-3	107.5	17.0	0.953	5.1
	MEAN	103.3	18.5				0.961	1.4
CTTP1/T1	JUL2, T22	104.8	17.4	P-12	116.0	12.0	0.903	5.4
(POSTCON)	JUL2, T23	104.1	18.9	P-12	116.0	12.0	0.897	6.9
	JUL2, T24	101.9	15.4	P-12	116.0	12.0	0.878	3.4
	JUL2, T25	102.4	22.1	P-12	116.0	12.0	0.883	10.1
	MEAN	103.3	18.5				0.891	6.5

TABLE 2. CTTP2 TAILINGS LIFT FIELD COMPACTION DATA.

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP2/T1	JUL2, T9	105.8	18.3	P-3	107.5	17.0	0.984	1.3
	JUL2, T10	106.3	19.0	P-3	107.5	17.0	0.989	2.0
CTTP2/T2	JUL2, T12	101.0	23.8	P-3	107.5	17.0	0.940	6.8
(PRECON)	JUL2, T13	106.4	20.1	P-3	107.5	17.0	0.990	3.1
	JUL2, T14	106.4	18.6	P-3	107.5	17.0	0.990	1.6
	JUL2, T15	105.4	20.1	P-3	107.5	17.0	0.980	3.1
	JUL2, T16	99.8	24.6	P-3	107.5	17.0	0.928	7.6
	MEAN	104.4	20.6				0.972	3.6
CTTP2/T1	JUL2, T9	105.8	18.3	P-11	117.5	13.0	0.900	5.3
	JUL2, T10	106.3	19.0	P-11	117.5	13.0	0.905	6.0
CTTP2/T2	JUL2, T12	101.0	23.8	P-11	117.5	13.0	0.860	10.8
(POSTCON)	JUL2, T13	106.4	20.1	P-11	117.5	13.0	0.906	7.1
	JUL2, T14	106.4	18.6	P-11	117.5	13.0	0.906	5.6
	JUL2, T15	105.4	20.1	P-11	117.5	13.0	0.897	7.1
	JUL2, T16	99.8	24.6	P-11	117.5	13.0	0.849	11.6
	MEAN	104.4	20.6				0.889	7.6

TABLE 3. CTTP4 TAILINGS LIFT FIELD COMPACTION DATA.

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP4/T1	JUL2, T26	103.7	20.3	P-3	107.5	17.0	0.965	3.3
(PRECON)	JUL2, T27	104.2	22.0	P-3	107.5	17.0	0.969	5.0
	JUL2, T28	105.0	18.4	P-3	107.5	17.0	0.977	1.4
	JUL2, T29	104.0	20.8	P-3	107.5	17.0	0.967	3.8
	JUL2, T30	101.0	23.8	P-3	107.5	17.0	0.940	6.8
	MEAN	103.6	21.1				0.964	4.1
CTTP4/T1	JUL2, T26	103.7	20.3	P-10	116.0	13.5	0.894	6.8
(POSTCON)	JUL2, T27	104.2	22.0	P-10	116.0	13.5	0.898	8.5
	JUL2, T28	105.0	18.4	P-10	116.0	13.5	0.905	4.9
	JUL2, T29	104.0	20.8	P-10	116.0	13.5	0.897	7.3
	JUL2, T30	101.0	23.8	P-10	116.0	13.5	0.871	10.3
	MEAN	103.6	21.1				0.893	7.6

TABLE 4. CTTP5 TAILINGS LIFT FIELD COMPACTION DATA.

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP5/T1	JUL3, T8	110.6	15.1	P-3	107.5	17.0	1.029	-1.9
(PRECON)	JUL3, T9	102.4	15.0	P-3	107.5	17.0	0.953	-2.0
	JUL3, T10	103.0	12.6	P-3	107.5	17.0	0.958	-4.4
	JUL3, T11	110.4	15.4	P-3	107.5	17.0	1.027	-1.6
	MEAN	106.6	14.5				0.992	-2.5

NOTE: NO PROCTOR SAMPLE WAS COLLECTED DURING CONSTRUCTION OF THE TAILINGS LIFT FOR CTTP5.

TABLE 5. CTTP1 INFILRATION BARRIER LAYER FIELD COMPACTION DATA.

PROCTOR DATA FROM PRECONSTRUCTION SAMPLES

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP1/1	JUL3, T2	107.5	19.9	P-6	110.0	18.0	0.977	1.9
	JUL3, T3	109.9	20.0	P-6	110.0	18.0	0.999	2.0
	JUL3, T4	109.6	18.5	P-6	110.0	18.0	0.996	0.5
	JUL3, T5	107.8	19.1	P-6	110.0	18.0	0.980	1.1
CTTP1/2	JUL3, T12	103.8	22.2	P-6	110.0	18.0	0.944	4.2
	JUL3, T13	105.4	19.9	P-6	110.0	18.0	0.958	1.9
	JUL3, T14	106.2	20.1	P-6	110.0	18.0	0.965	2.1
	JUL3, T15	104.1	21.0	P-6	110.0	18.0	0.946	3.0
CTTP1/3	JUL3, T34	107.9	18.5	P-6	110.0	18.0	0.981	0.5
	JUL3, T35	103.2	20.1	P-6	110.0	18.0	0.938	2.1
	JUL3, T36	103.2	21.5	P-6	110.0	18.0	0.938	3.5
	JUL3, T37	101.7	20.8	P-6	110.0	18.0	0.925	2.8
	MEAN	105.9	20.1				0.962	2.1

PROCTOR DATA FROM SAMPLES COLLECTED DURING PAD CONSTRUCTION (WHEN AVAILABLE)

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP1/1	JUL3, T2	107.5	19.9	P-13	113.0	15.5	0.951	4.4
	JUL3, T3	109.9	20.0	P-13	113.0	15.5	0.973	4.5
	JUL3, T4	109.6	18.5	P-13	113.0	15.5	0.970	3.0
	JUL3, T5	107.8	19.1	P-13	113.0	15.5	0.954	3.6
CTTP1/2	JUL3, T12	103.8	22.2	P-15	109.5	18.5	0.948	3.7
	JUL3, T13	105.4	19.9	P-15	109.5	18.5	0.963	1.4
	JUL3, T14	106.2	20.1	P-15	109.5	18.5	0.970	1.6
	JUL3, T15	104.1	21.0	P-15	109.5	18.5	0.951	2.5
CTTP1/3	JUL3, T34	107.9	18.5	P-6	110.0	18.0	0.981	0.5
	JUL3, T35	103.2	20.1	P-6	110.0	18.0	0.938	2.1
	JUL3, T36	103.2	21.5	P-6	110.0	18.0	0.938	3.5
	JUL3, T37	101.7	20.8	P-6	110.0	18.0	0.925	2.8
	MEAN	105.9	20.1				0.955	2.8

TABLE 6. CTTP2 INFILRATION BARRIER LAYER FIELD COMPACTION DATA.

PROCTOR DATA FROM PRECONSTRUCTION SAMPLES

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP2/1	JUL9, T13	108.6	15.4	P-18	114.0	16.5	0.953	-1.1
	JUL9, T14	106.0	18.4	P-18	114.0	16.5	0.930	1.9
	JUL9, T15	110.0	14.2	P-18	114.0	16.5	0.965	-2.3
	JUL9, T16	111.9	15.5	P-18	114.0	16.5	0.982	-1.0
CTTP2/2	JUL9, T18	104.5	18.7	P-18	114.0	16.5	0.917	2.2
	JUL9, T20	104.3	21.8	P-18	114.0	16.5	0.915	5.3
	JUL9, T21	109.1	16.4	P-18	114.0	16.5	0.957	-0.1
	JUL9, T22	105.6	21.7	P-18	114.0	16.5	0.926	5.2
CTTP2/3	JUL9, T23	108.9	16.8	P-18	114.0	16.5	0.955	0.3
	JUL9, T24	113.2	15.2	P-18	114.0	16.5	0.993	-1.3
	JUL9, T25	112.4	16.0	P-18	114.0	16.5	0.986	-0.5
	JUL9, T26	103.3	18.8	P-18	114.0	16.5	0.906	2.3
	MEAN	108.2	17.4				0.949	0.9

PROCTOR DATA FROM SAMPLES COLLECTED DURING PAD CONSTRUCTION (WHEN AVAILABLE)

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP2/1	JUL9, T13	108.6	15.4	P-21	112.5	17.5	0.965	-2.1
	JUL9, T14	106.0	18.4	P-21	112.5	17.5	0.942	0.9
	JUL9, T15	110.0	14.2	P-21	112.5	17.5	0.978	-3.3
	JUL9, T16	111.9	15.5	P-21	112.5	17.5	0.995	-2.0
CTTP2/2	JUL9, T18	104.5	18.7	P-18	114.0	16.5	0.917	2.2
	JUL9, T20	104.3	21.8	P-18	114.0	16.5	0.915	5.3
	JUL9, T21	109.1	16.4	P-18	114.0	16.5	0.957	-0.1
	JUL9, T22	105.6	21.7	P-18	114.0	16.5	0.926	5.2
CTTP2/3	JUL9, T23	108.9	16.8	P-18	114.0	16.5	0.955	0.3
	JUL9, T24	113.2	15.2	P-18	114.0	16.5	0.993	-1.3
	JUL9, T25	112.4	16.0	P-18	114.0	16.5	0.986	-0.5
	JUL9, T26	103.3	18.8	P-18	114.0	16.5	0.906	2.3
	MEAN	108.2	17.4				0.953	0.6

TABLE 7. CTTP4 INFILRATION BARRIER LAYER FIELD COMPACTION DATA.

PROCTOR DATA FROM PRECONSTRUCTION SAMPLES

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP4/1	JUL3, T39	113.8	15.5	P-8/9	122.0	12.5	0.933	3.0
	JUL3, T40	115.9	15.4	P-8/9	122.0	12.5	0.950	2.9
	JUL3, T41	113.0	15.8	P-8/9	122.0	12.5	0.926	3.3
	JUL3, T42	116.6	14.2	P-8/9	122.0	12.5	0.956	1.7
CTTP4/2	JUL3, T43	116.3	14.2	P-8/9	122.0	12.5	0.953	1.7
	JUL3, T44	116.9	10.5	P-8/9	122.0	12.5	0.958	-2.0
	JUL3, T45	118.8	11.0	P-8/9	122.0	12.5	0.974	-1.5
	JUL3, T46	118.3	12.5	P-8/9	122.0	12.5	0.970	0.0
CTTP4/3	JUL3, T47	118.7	12.8	P-8/9	122.0	12.5	0.973	0.3
	JUL3, T48	117.8	13.3	P-8/9	122.0	12.5	0.966	0.8
	JUL3, T49	120.0	12.6	P-8/9	122.0	12.5	0.984	0.1
	JUL3, T50	116.4	13.6	P-8/9	122.0	12.5	0.954	1.1
	MEAN	116.9	13.5				0.958	1.0

PROCTOR DATA FROM SAMPLES COLLECTED DURING PAD CONSTRUCTION (WHEN AVAILABLE)

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP4/1	JUL3, T39	113.8	15.5	P-8/9	122.0	12.5	0.933	3.0
	JUL3, T40	115.9	15.4	P-8/9	122.0	12.5	0.950	2.9
	JUL3, T41	113.0	15.8	P-8/9	122.0	12.5	0.926	3.3
	JUL3, T42	116.6	14.2	P-8/9	122.0	12.5	0.956	1.7
CTTP4/2	JUL3, T43	116.3	14.2	P-17	120.5	13.5	0.965	0.7
	JUL3, T44	116.9	10.5	P-17	120.5	13.5	0.970	-3.0
	JUL3, T45	118.8	11.0	P-17	120.5	13.5	0.986	-2.5
	JUL3, T46	118.3	12.5	P-17	120.5	13.5	0.982	-1.0
CTTP4/3	JUL3, T47	118.7	12.8	P-16	120.0	13.0	0.989	-0.2
	JUL3, T48	117.8	13.3	P-16	120.0	13.0	0.982	0.3
	JUL3, T49	120.0	12.6	P-16	120.0	13.0	1.000	-0.4
	JUL3, T50	116.4	13.6	P-16	120.0	13.0	0.970	0.6
	MEAN	116.9	13.5				0.967	0.5

TABLE 8. CTTP5 INFILRATION BARRIER LAYER FIELD COMPACTION DATA.

PROCTOR DATA FROM PRECONSTRUCTION SAMPLES

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP5/1	JUL9, T1	91.5	29.2	P-4	97.5	25.0	0.938	4.2
	JUL9, T2	87.0	33.1	P-4	97.5	25.0	0.892	8.1
	JUL9, T3	89.7	30.5	P-4	97.5	25.0	0.920	5.5
	JUL9, T4	94.6	27.8	P-4	97.5	25.0	0.970	2.8
CTTP5/2	JUL9, T5	92.0	28.5	P-4	97.5	25.0	0.944	3.5
	JUL9, T6	99.8	24.1	P-4	97.5	25.0	1.024	-0.9
	JUL9, T7R	98.6	25.0	P-4	97.5	25.0	1.011	0.0
	JUL9, T8	92.2	29.6	P-4	97.5	25.0	0.946	4.6
CTTP5/3	JUL9, T9	94.7	27.7	P-4	97.5	25.0	0.971	2.7
	JUL9, T10	92.7	30.0	P-4	97.5	25.0	0.951	5.0
	JUL9, T11	94.4	27.8	P-4	97.5	25.0	0.968	2.8
	JUL9, T12	99.5	24.3	P-4	97.5	25.0	1.021	-0.7
	MEAN	93.9	28.1				0.963	3.1

PROCTOR DATA FROM SAMPLES COLLECTED DURING PAD CONSTRUCTION (WHEN AVAILABLE)

PAD/LIFT	FIELD TEST NUMBER	FIELD DENSITY	FIELD MOISTURE	PROCTOR #	MAX. DRY DENS.	OPT. MOISTURE	COMPACTION	+/- OP MOIS
CTTP5/1	JUL9, T1	91.5	29.2	P-4	97.5	25.0	0.938	4.2
	JUL9, T2	87.0	33.1	P-4	97.5	25.0	0.892	8.1
	JUL9, T3	89.7	30.5	P-4	97.5	25.0	0.920	5.5
	JUL9, T4	94.6	27.8	P-4	97.5	25.0	0.970	2.8
CTTP5/2	JUL9, T5	92.0	28.5	P-20	98.0	25.5	0.939	3.0
	JUL9, T6	99.8	24.1	P-20	98.0	25.5	1.018	-1.4
	JUL9, T7R	98.6	25.0	P-20	98.0	25.5	1.006	-0.5
	JUL9, T8	92.2	29.6	P-20	98.0	25.5	0.941	4.1
CTTP5/3	JUL9, T9	94.7	27.7	P-4	97.5	25.0	0.971	2.7
	JUL9, T10	92.7	30.0	P-4	97.5	25.0	0.951	5.0
	JUL9, T11	94.4	27.8	P-4	97.5	25.0	0.968	2.8
	JUL9, T12	99.5	24.3	P-4	97.5	25.0	1.021	-0.7
	MEAN	93.9	28.1				0.961	3.0

APPENDIX A

DAILY FIELD REPORTS

APPENDIX A

DAILY FIELD REPORTS

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, MT 59702
(406) 782-5177

DAILY FIELD REPORT

Page 1 of 1

DATE/TIME: 7/1/96

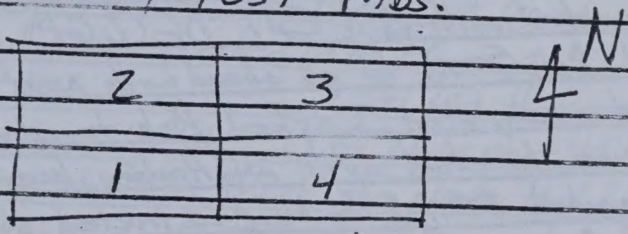
PROJECT LAO/CLARK
JOB NO. 4502
CLIENT ARCO
CONTRACTOR JORDAN
PROJECT MANAGER ARCHIBALD

DAY: S __ M X T __ W __ TH __ F __ S __
WEATHER: Brite Sun X Clear __ Overcast __ Rain __ Snow __
TEMP.: To 32 __ 32-50 __ 50-70 __ 70-85 X 85 up __
WIND: Still __ Moder. X High __
HUMIDITY: Dry __ Moder. X Humid __

FIELD ACTIVITIES:

ARRIVED ON-SITE AT 1210 (ARCHIBALD, SAMPSON). TOOK MOISTURE READINGS ON UNCOMPACTED TEST PAD SUBGRADE. FOUND MATERIALS WELL DRY OF OPTIMUM, ADVISED BOB LASH (JORDAN FOREMAN) TO ADD WATER.

LABELED AREA FOR 4 TEST PADS:



JORDAN ADDED WATER AND BEGAN COMPACTING W/ INGERSOLL RAND SD-48 VIBRATORY SHEEPSFOOT. PERFORMED NUMEROUS COMPACTION TESTS. FOUND MATERIAL GENERALLY NEAR DENSITY SPEC BUT WELL DRY OF OPTIMUM MOISTURE. DIRECTED JORDAN PERSONNEL TO ADD MORE WATER. TESTED AGAIN. GENERALLY MET COMPACTION SPEC, BUT STILL WELL DRY OF OPTIMUM. DIRECTED JORDAN TO ADD WATER A THIRD TIME. AGAIN, MET COMPACTION SPEC BUT DRY. AT 1630, ADVISED BOB LASH TO SOAK DOWN BEFORE LEAVING FOR THE DAY MAKE A PASS WITH COMPACTOR AND WE'D RE-TEST IN AM.

KEN BROCKMAN (B.R. OF REC) ONSITE 1600 - 1645. ERIC JACOBSEN SAID WE WOULD PROCEED WITH TEST PAD CONSTRUCTION TOMORROW. WILL BEGIN LAYING TAILINGS APPROX 8 a.m.

BY BRAD ARCHIBALD TITLE SR. ENGINEER

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DAILY FIELD REPORT

Page 1 of 3

PROJECT LAO/CLARK
JOB NO. 4502
CLIENT ARCO
CONTRACTOR JCI
PROJECT MANAGER ARCHIBALD

DATE/TIME: 7-2-96
DAY: S __ M __ T X W __ TH __ F __ S __
WEATHER: Brite Sun __ Clear X Overcast __ Rain __ Snow __
TEMP.: To 32 __ 32-50 __ 50-70 __ 70-85 X 85 up __
WIND: Still X Moder. __ High __
HUMIDITY: Dry __ Moder. __ Humid __

FIELD ACTIVITIES:

8:00AM- Arrived at site with Brad, filling of test pads CTTP3, JCI thyed one 12" lift and went on filling CTTP2. In the process vibratory compaction attempted to compact CTTP3 & sank on the first pass. JCI cut 18" loose lift down to 12" & attempted to compact again but was unsuccessfull. After four attempts at compacting CTTP3 a group decision consitting of Brad, Bob, & Eric CTTP3 was abandoned. 10:50AM- CTTP2 was completed with first 8" lift of Tails. CTTP2 was compacted with a CAT D6 (LGP). Two test taken passed & I told Bob (JCI) to go ahead with next 4" lift. 2nd lift completed & five tests completed. I asked Bob to wait until after lunch when Brad returned to start with infiltration barrier layer. After lunch Eric (ARCO) designated CTTP2 to be constructed of 75% LAO Clays & 25% decomposed Granit from Hollows pit for infiltration barrier. The infiltration barrier was mixed near test pads with JCI loader. This mixture was then placed on CTTP2 with loader & spread with D6. I was told by Eric to test for compaction & moisture after first 6" lift was compacted with D6. This was completed ~~and~~ determined that this mixture was highly moist and did not pass density tests T39 & T40. After these test it was determined by BRAD that CTTP2 will be left to dry over night and attempt to compact & density test the next day 7-3-96.

BY Pat Sampson TITLE

DAILY FIELD REPORT (cont'd.)

Page 2 of 3

DATE/TIME: 7-2-96

PROJECT: LAO/CLARK

JOB NO. 4502

FIELD ACTIVITIES (cont'd.):

CTTP1 — This test pad was constructed with tails from pit #2 and infiltration barrier consisting of 50% LAO clays and 50% silty sand from Hollows pit as recomended by Eric (ARCO).

Tails were placed in one 12" lift from pit #2 and compacted with CAT D6 (LGP) Low Ground Pressure. After compaction was completed Field Density tests T22 thru T26 concluded that CTTP1 had passed 95% density and approved by Brad as he referenced to plates P2 & P3.

Infiltration barrier layer consisting of 50% LAO clays & 50% silty sand was premixed with JCI Loader near test pads. This layer was placed on CTTP1 with a loader, spread and compacted with D6, in a 9" loose lift that compacted down to between 5-6" lift (lift thicknesses measured by Bob Lash JCI). Brad advised Bob (JCI) to place next lift alittle thicker and to make sure Not to loose the lath that he was taking measurement from. Field density tests T34 thru T38 concluded that the first lift of CTTP1 were good and they were approved by Brad.

CTTP1 was finished for this day 7-2-96 & will be continued on 7-3-96

Samples taken from CTTP1

CTTP1-Tails 0-12"

CTTP1-Lift 1

BY Pat Samps.

TITLE

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DAILY FIELD REPORT (cont'd.)

Page 3 of 3

DATE/TIME: 7-2-96

PROJECT LAO/CLARK
JOB NO. 4502

FIELD ACTIVITIES (cont'd.):

CTTP4 – This test pad was constructed with tails from pit #1 and infiltratio barrier layer consisting of 100% silty sand from Hollows pit @ 90% density.

Tails from pit #1 were placed in CTTP4 in one 12" lift. CTTP4 was compacted in the following order until Field density tests passed

1. 4 Pass CAT D6 (LGP)
2. 4 Pass Roller (No Vibration)
3. 4 Pass CAT D6 (LGP)
4. 4 Pass Roller w/ Vibration

Test T41 thru T44 allowed Brad to approve density of CTTP4

The first layer for infiltration barrier consisting of 100% silty clay was placed in 6" lift. Density tests T45 + T46 were conducted & it was the determine that moisture content was low Rob (JCI) was instructed to wet down tonight and then let it go until tommarow 7-3-96.

CTTP5 – This test pad was constructed by JCI as instructed by Eric (ARCO) because CTTP3 was thrown out.

Tails placed in CTT5 were from pit #2 in first 8" lift. This first lift looked very wet & Density tests T31 thru T33 proved this. This test pad was to dry overnight and be compacted on 7-3-96 as per Brad & Eric (ARCO).

Left site at 4:50. At this time JCI was to spread mixed materials and finish hauling materials to site all work on test pads finished for this day 7-2-96

BY Pat Sampson TITLE

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DAILY FIELD REPORT

Page 1 of 3

DATE/TIME: 7/3/96

PROJECT: LAO/CLARK
JOB NO. 4502
CLIENT: ARCO
CONTRACTOR: JCI
PROJECT MANAGER: ARCHIBALD

DAY: S__ M__ T__ W X TH__ F__ S__
WEATHER: Brite Sun __ Clear X Overcast __ Rain __ Snow __
TEMP.: To 32 __ 32-50 __ 50-70 __ 70-85 X am 85 up X pm
WIND: Still __ Moder. X High __
HUMIDITY: Dry __ Moder. X Humid __

FIELD ACTIVITIES:

0730 BOTH CAP MIXTURES (THE 50% LAO CLAYS / 50% HOLLOW SILT AND 75% LAO CLAY / 25% DG) WERE SPREAD LAST NIGHT TO DRY. BOTH PUSHED BACK INTO STOCKPILES THIS AM.

CTTP1: 50% LAO CLAY / 50% HOLLOW SILT.
HAD JCI ROLL SURFACE OF LIFT 1 w/ DOZER (CAT D6H LGP) TO PROVIDE UNIFORM SURFACE, HEAL ANY DESSICATION CRACKS FROM OVERNIGHT. CHECKED AND PASSED LIFT 1 BASED ON TESTS T2 - T5.

PLACED 2ND LIFT ON CTTP1 - 9" LOOSE LIFT. COMPACTED w/ D6H LGP DOZER. ~~RAS~~ APPROVED LIFT BASED ON TESTS T12 - T15.

PLACED 3RD LIFT ON CTTP1 - 9" LOOSE LIFT. COMPACTED w/ 4 PASSES OF D6H LGP DOZER. IMMEDIATELY AFTER PLACEMENT AND COMPACTION, MATERIAL MET DENSITY SPEC BUT WAS SLIGHTY TOO WET. AFTER DRYING FOR APPROX. 2HRS, APPROVED 3RD LIFT BASED ON TESTS T34 - T37. COVERED COMPLETED PAD WITH ~~A~~ 3" I LIFT OF DECOMPOSED GRANITE AND VISQUENE. SET FINAL GRADE ON INFILTRATION BARRIER: THICKNESS 1.5' ± 0.1 FOOT.

CTTP2: 75% LAO CLAYS / 25% DECOMPOSED GRANITE.
CHECKED MOISTURE CONTENT ON 1st LIFT (THAT WAS PLACED YESTERDAY). LIFT IS STILL FAR TOO MOIST (T20 - T25). AFTER ATTEMPTING TO RIP

BY: BRAD ARCHIBALD TITLE: SR. ENGINEER

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DAILY FIELD REPORT (cont'd.)

Page 2 of 3

DATE/TIME: 7/3/96

PROJECT LAO/CLARK

JOB NO. 4502

FIELD ACTIVITIES (cont'd.):

THE LIFT TO AID IN DRYING AND SINKING THE GRADER, WE DETERMINED TO ABANDON THE 75% LAO/25% DG TEST PAD.

CTTP4: 100% HOLLOW SILTY SAND.
RIPPED FIRST LIFT (PLACED YESTERDAY) AND ADDED WATER AT 0745. CHECKED MOISTURE (T6-T7) AND FOUND STILL TOO DRY. WATERED AND CHECKED AGAIN (T15) - STILL TOO DRY. HAD IT RIPPED AND WATERED AGAIN @ 0945. TESTED AGAIN (T30-T32) STILL SLIGHTLY DRY OF OPTIMUM TO +4% SPEC. RIPPED AND ADDED WATER AGAIN. COMPACTED WITH 8 PASSES OF INGERSOLRAND SP-48 SHEEPSFOOT W/ VIBRATOR OFF. MOISTURE 2-3% ABOVE OPTIMUM. SLIGHTLY BELOW TARGET SPEC OF 95% COMPACTION, BUT APPROVED LIFT BASED ON TESTS T39-42. COMPACTED LIFT THICKNESS EQUAL 6" ±.

PLACED LIFT 2 @ 1325. ADDING WATER AS SPREADING MATERIAL. COMPACTED LIFT W/ 4 PASSES OF IR SP-48 WITH VIB. OFF. 2 OF 4 TESTS SHOWED MATERIAL SLIGHTLY DRY OF OPTIMUM, BUT ALL MET TARGET DENSITY OF 95%. APPROVED LIFT.

PLACED LIFT 3 @ 1620. ADDING AS MUCH WATER AS POSSIBLE DURING SPREADING. COMPACTED LIFT W/ 4 PASSES OF SP-48 W/ VIB. OFF. APPROVED LIFT BASED ON TESTS T47-T50. FINAL THICKNESS OF INF. BARRIER MATERIALS EQUAL 1.5 TO 1.6 FEET. PLACED 3" ± OF DECOMPOSED GRANITE AND VISQUENE OVER COMPLETED PAD.

BY BRAD ARCHIBALD TITLE SR ENGINEER

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DAILY FIELD REPORT (cont'd.)

Page 3 of 3

DATE/TIME: 7/3/96

PROJECT LAO/CLARK
JOB NO. 4502

FIELD ACTIVITIES (cont'd.):

CTTP5: APPROVED TAILINGS LIFT, WHICH HAD BEEN TOO WET YESTERDAY. HAD APR DRIED OVERNIGHT. APPROVED @ 0910 BASED ON TEST T8-T11. DID NOT PLACE ANY INF. BARRIER MATERIALS ON PAD 5.

MISCELLANEOUS: MEASURED MOISTURE CONTENT IN CLAY STOCKPILE (WHICH HAD BEEN THIN SPREAD OVERNIGHT TO DRY). STILL VERY WET OF OPTIMUM (TESTS T18, 19, 33).

SAMPLES COLLECTED:

CTTP4-T44 -	FROM LOCATION OF T44 FOR MOISTURE (ASTM D2216) ANALYSIS.
CTTP4-T40 -	FROM T40 FOR MOISTURE ANALYSIS
CTTP4-T42	FROM T42 FOR MOISTURE ANALYSIS.
CTTP4-T46 -	FROM T46 FOR MOISTURE ANALYSIS
CTTP1-LIFT 2	COMPOSITE FROM SECOND LIFT PLACED ON CTTP1.
CTTP1-LIFT 3	COMPOSITE OF 3RD LIFT PLACED ON CTTP1.
CTTP4-LIFT 2	COMPOSITE OF 2ND LIFT PLACED ON CTTP4.
CTTP4-LIFT 3	COMPOSITE OF 3RD LIFT PLACED ON CTTP4.

BY BRAD ARCHIBALD TITLE SR. ENGINEER

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DAILY FIELD REPORT

Page 1 of 1

PROJECT LAO/Clark
JOB NO. 4502
CLIENT ARCO
CONTRACTOR JCI
PROJECT MANAGER ARCHIBALD

DATE/TIME: 7-9-96
DAY: S __ M __ T X W __ TH __ F __ S __
WEATHER: Brite Sun __ Clear X Overcast __ Rain __ Snow __
TEMP.: To 32 __ 32-50 __ 50-70 __ 70-85 X 85 up __
WIND: Still __ Moder. X High __
HUMIDITY: Dry __ Moder. __ Humid __

FIELD ACTIVITIES:

Before I arrived at LAO CTTP2 was cleared of old infiltration barrier material that was in place from a previous a test. CTTP2 was assigned to be covered with 50% Peat & 50% decomposed gravit. This material was dry of optimum in the stock pile which was tested for moisture. Bob Lash (JCI) watered material as it was being spread with CAT D6 (LGP). The target of 90-95% for compaction was acheived on the first lift determined by Nuclear Gauge Density Tests T13 thru T16. Rob Lash was told this target from Eric (ARCO) by cell-phone. The next two lifts were placed in sequence and both were watered as the lifts were being placed. Lift #2 was checked by Density Tests T17 thru T22 and Lift #3 was checked by T23 thru T26. All Lifts on CTTP2 passed targeted compaction by being compacted by CAT D6 (LGP) with four passes. CTTP2 was then covered with visqueen and approximately one inch of sand over the visqueen.

CTTP5 was completed with 100% Peat as the infiltration barrier. Target compaction for CTTP5 was the same as CTTP2 (between 90-95%) This material Needed no additional moisture because it was very wet when excavated and allowed to dry from the previous week.

The first lift was field Density tested (T-1 thru T4) and compaction was achieved. The second lift and third lift were also tested in sequence after placement and compaction (2nd Lift T5-T8) (3rd T9-T12). All Lifts passed target compaction.

Composite samples from CTTP2 and CTTP5 were taken from each Lift of these two test pads. These two test pads were constructed alittle smaller than previous because Bob (JCI) asked to cut them by about five feet; he was worried about not having enough material. I told him that it was OK.

BY Pat Semple TITLE

APPENDIX B

FIELD DENSITY TEST RESULTS

7/1/96

Pioneer Technical Services, Inc.
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FIELD DENSITY TEST SUMMARY

90% = 106.7 pcf

Project LAU/CLARK
Project No. 4502
Tests on TEST PAD SUBGRADE, 0-6"
Page 1 of 2

	Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
MSE	1	7-1-96	NG	3.73	110.7	106.7	P-1	118.5	9	90	UNCOMPACTED TEST
Pion.	2			12.95	110.5	97.9					PAD SUBGRADE MOISTURE TESTS FOR BAR
15 MSE	3			3.29	116.8	112.4					LASH TO DETERMINE IF WATERING NECESSARY
15 Pion	4			9.53	118.4	108.1	MOISTURE SAMPLES TO BRAUN, 7/1/96				BEFORE COMPACTION, USING PIONEER'S
1N MSE				4.45	121.0	115.9					AND MSE'S GAUGE
1N Pion.				8.74	117.6	108.2					FOR COMPARISON.
2S MSE				3.38	111.9	108.2					
2S Pion.				7.31	109.2	101.7					
2N MSE				2.98	113.4	110.1					
Pion.	10P	7/1/96	NG	2.29	117.0	114.4	P-1	118.5	96.5	90	2N AFTER 3 PASSES W/ IR SP-48
MSE	10m			4.3	114.6	109.9	P-1	118.5	92.7	90	2N "
	11P			2.09	116.3	113.9	P-1	118.5	96.1	90	2S
	11M			4.02	113.0	108.7	P-1	118.5	91.7	90	"
	12M			4.4	109.9	105.3	P-1	118.5	88.9	90	1SE AFTER WATER, COMP.
TOLD OPERATOR (BRIAN NELSON) NEEDS MORE WATER.	12P		NG	3.7	110.9	106.9	P-1	118.5	90.2	90	" "
	13P			4.85	121.9	116.3	P-1	118.5	98.1	90	After 2nd Water, Co
	13M			6.46	121.3	114.0	P-1	118.5	96.2	90	~~1S 4 SOUTH~~ 1 SOUTH
	14M			5.4	126.7	120.2	P-1	118.5	101.4	90	4 SOUTH
	14P			4.02	128.0	123.1	P-1	118.5	103.9	90	" "

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

NOTE: 2 GAUGES USED TODAY BECAUSE OF QUESTIONABLE STANDARD COUNT ON PIONEER GAUGE.

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FIELD DENSITY TEST SUMMARY

Project LAO/CLARK
Project No. 4502
Tests on TEST PAD SUBGRADE, 0-6"
Page 2 of 2

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
@1330 15M	7/1/96	NG	6.8	118.5	111.0	P-1	118.5	93.7	90	3N - AFTER 2ND WATER ADD.
15P		NG	4.6	119.5	114.3	P-1	118.5	96.5	90	"
16M		NG	4.6	115.7	110.6	P-1	118.5	93.3	90	3SE-
16P		NG	3.4	117.0	113.1	P-1	118.5	95.4	90	3SE
TOLD OPERATOR TO ADD WATER ONCE MORE.										
MEASURED A BACKSCATTER MOISTURE @ 2-MID - % MOISTURE = 10.2. WATER IS PRESENT										
AT SURFACE, JUST NOT PENETRATING.										
@1405 17M	7/1/96	NG	7.0	121.0	113.1	P-1	118.5	95.4	90	+CENTRAL BOA 1 CENTRAL
17P			5.5	122.7	116.2	P-1	118.5	98.1	90	"
18M			7.8	122.8	113.9	P-1	118.5	96.2	90	4-CENTRAL
18P			5.4	123.1	116.8	P-1	118.5	98.6	90	"
19M			6.6	120.0	112.5	P-1	118.5	94.9	90	4-NE
19P			4.55	121.0	115.5	P-1	118.5	97.5	90	4-NE
20M			5.5	115.2	109.2	P-1	118.5	92.2	90	3-SOUTH
20P			3.7	116.4	112.2	P-1	118.5	94.7	90	
21M			6.3	116.1	109.2	P-1	118.5	92.2	90	3-NW
21P			4.0	117.5	113.0	P-1	118.5	95.4	90	
22M			5.5	114.9	109.0	P-1	118.5	92.0	90	2-NORTH
22P			3.2	116.3	112.7	P-1	118.5	95.1	90	
1645 TOLD BOB LASH, TCI FOREMAN, TO SOAK PADS TONIGHT, ROLL ONCE IN AM, AND WE'D CHECK IN AM										

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

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FIELD DENSITY TEST SUMMARY

P2 - 105.5 -

Project LAO/CLARK
Project No. 4502
Tests on TEST PAD TAILINGS
Page 1 of 3

MSE Pad

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T1-m	7/2/96	NG	17.2	123.8	105.6	P-3	107.5	98.2	95	CTTP3 TAILS, 0-10" 2 PASSES
T1-P			22.3	123.2	100.7	P3	107.5	93.7	95	
T2-P			31.14	121.7	92.8	P-3	107.5	86.3	95	" " 4 Pass
T3-P			30.04	123.1	94.7	P-3	107.5	88.1	95	" "
T4-P			25.5	121.6	96.7	P-3	107.5	90.0	95	2 Vib
T5-P			23.8	118.2	95.4	P-3	107.5	88.7	95	4 Vib
T6-			26.21	122.9	97.4	P-3	107.5	90.6	95	Pad #4 12" Just Placed
T7			20.15	124.1	103.3	P-3	107.5	96.1	95	Pad #4 4 Pass No V
T8			21.62	124.7	102.5	P-3	107.5	95.4	95	Pad #4 Same
T9			18.27	125.1	105.8	P-3	107.5	98.4	95	#2 No Compactor
T10			19.04	126.6	106.3	P-3	107.5	98.9	95	" "
T11			5.59	125.4	118.6	P-1	118.5	100	90	#5 Subgrade
T12			23.78	125.0	101.0	P-3	107.5	94.0	95	#2 4" Top Lift
T13			20.55	128.2	106.4	P-3	107.5	99.0	95	" "
T14			18.61	126.2	106.4	P-3	107.5	99.0	95	" "
T15			20.99	127.6	105.4	P-3	107.5	98.0	95	" "
T16			24.55	124.3	99.8	P-3	107.5	92.8	95	" "
T17			22.19	125.0	102.3	P-3	107.5	95.2	95	#4 CAT. Compaction
T18			18.22	125.4	106.1	P-3	107.5	98.7	95	" "

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

NOTE: WITH EXCEPTION(TAH) USED PIONEER CPN MC-3 GAUGE ONLY. GOOD STANDARD COUNT(S) ON PIONEER GAUGE TODAY.

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FIELD DENSITY TEST SUMMARY

D3 - 101.7

Project LAO/CLARK
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Tests on TEST PADS
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Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T19	7-2-96	NG	18.13	125.5	106.2	P-3	107.5	98.8	95	#4 12"
T20			18.9	130.5	109.8	P-3	107.5	102.1	95	" "
T21			22.28	125.9	102.9	P-3	107.5	95.7	95	" "
T22			17.44	123.1	104.8	P-3	107.5	97.5	95	#1 12" CAT Tracked
T23			18.89	123.8	104.1	P-3	107.5	96.8	95	" "
T24			15.38	117.5	101.9	P-3	107.5	94.8	95	" "
T25			22.09	125.0	102.4	P-3	107.5	95.3	95	" "
T26			20.29	124.7	103.7	P-3	107.5	96.5	95	#4 2nd CAT Track
T27			22.01	127.2	104.2	P-3	107.5	96.9	95	" "
T28			18.36	124.2	105.0	P-3	107.5	97.7	95	" "
T29			20.8	125.6	104.0	P-3	107.5	96.7	95	" "
T30			23.8	124.3	101.0	P-3	107.5	94.0	95	" "
T31			23.54	123.7	100.1	P-3	107.5	93.1	95	#5 8" CAT Tracks
T32			20.8	125.4	103.8	P-3	107.5	96.6	95	" "
T33			27.74	124.3	97.3	P-3	107.5	90.5	95	" "
T34			24.35	128.5	103.3	P-6	110.0	93.9	90-TARGET	#1 6" ½ Peat + ½ Hol
T35			24.37	131.0	105.3	P-6	110.0	95.7	90-TARGET	#1 6" "
T36			22.28	129.7	106.1	P-6	110.0	96.5	90-TARGET	" "
T37			30.95	117.2	89.5	P-6	110.0	81.4	90-TARGET	" "
T38			23.35	129.9	105.3	P-6	110.0	95.7	90-TARGET	" "

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

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P-8 → 95% = 115.9

FIELD DENSITY TEST SUMMARY

Project LAO / CLARK
Project No. 4502
Tests on TEST PADS
Page 3 of 3

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T39	7-2-96	NG	37.59	119.0	86.5	P-7	103.5	83.6	90-TARG.	#2 1st 6" Lift 75/25
T40			31.13	121.9	92.9	P-7	103.5	89.8	90-TARG.	" "
T41			18.98	128.1	102.6	P-8	107.5	106.1	95	#4 Tails 12" after Compactor
T42			10.91	113.1	102.0	P-8	107.5	94.9	95	" "
T43			39.72	131.3	94.0	P-8	107.5	87.4	95	" "
T44			20.11	124.4	103.6	P-8	107.5	96.4	95	" "
T43R			18.53	122.2	102.3	P-8	107.5	99.8	95	Retest Near T43
T45			9.44	125.5	114.7	P-8	122.0	94.0	95-TARG.	#4 1st 6" 100% Hollow
T46	7-2-96		11.5	123.4	111.1	P-8	122.0	91.1	95-TARG.	" "

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

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FIELD DENSITY TEST SUMMARY

Project LAU/CLARK
Project No. 4502
Tests on TEST PADS
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PIONEER GAUGE

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T1	7-3-96	NG	19.5	127.9	107.0	P-6	110.0	97.3	90 TARG	#1 Lift 1
T2			19.9	128.8	107.5	P-6	110	97.7	90 TARG	#1, LIFT 1, SW CORNER
T3			20.0	131.9	109.9	P-6	110	99.9	90 TARG	#1, LIFT 1, NW CORNER
T4			18.52	129.9	109.6	P6	110	99.6	90 TARG	#1 Lift 1 SE Corner
T5			19.13	128.4	107.8	P-6	110	98.0	90 TARG	#1 Lift 1 NE C
T6			9.58	126.6	115.5	P-8	122	94.7	95 TARG	#4 Lift 1 N Center
T7			11.7	113.5	101.6	P-8	122	83.3	95 TARG	#4 Lift 1 SE C
T8			15.12	127.3	110.6	P-3	107.5	102.9	95	#5 Tails 0-8" NEC
T9			15.04	117.8	102.4	P-3	107.5	95.3	95	#5 Tails 0-8" NWc
T10			12.55	116.0	103.0	P-3	107.5	95.8	95	#5 Tails 0-8" SWc
T11			15.39	127.4	110.4	P-3	107.5	102.7	95	#5 Tails 0-8" SEc
T12			22.15	126.8	103.8	P-6	110	94.4	90 TARG	#1 Lift 2 SWc
T13			19.85	126.3	105.4	P-6	110	95.8	90 TARG	#1 Lift 2 NWc
T14			20.11	127.5	106.2	P-6	110	96.5	90 TARG	#1 LIFT 2 NEC
T15			21.0	126.0	104.1	P-6	110	94.6	90 TARG	#1, LIFT 2 SEC
T16			10.2	125.9	114.3	P-8/9	122	93.7	95 TARG	#4 LIFT 1, NEC
T17			24.7	122.3	98.1	P-7	103.5	94.8	90 TARG	#2 Lift 1 SEC
T18			58.2	98.1	62.1	P-4/5	97.5		NA	CLAY STOCKPILE
T19			45.5	105.5	72.5	P-4/5	97.5		NA	CLAY STOCKPILE

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

Pioneer Technical Services, Inc. P.O. Box 3445 Butte, MT 59702 (406) 782-5177	FIELD DENSITY TEST SUMMARY	Project LAO/CLARK Project No. 4502 Tests on TEST PADS Page 2 of 3

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T20	7-3-96	NG	19.5	127.0	106.3	P-7	103.5	102.7	90 TARG	#2 Lift 1 SEC
T21			18.2	124.8	105.6	P-7	103.5	102	90 TARG	#2 Lift 1 NEC
T22			24.8	121.6	97.4	P-7	103.5	94.1	90 TARG	#2 lift 1 NWC
T23			23.4	121.2	98.2	P-7	103.5	94.9	90 TARG	#2 Lift 1 SWC
T24			27.0	121.1	95.4	P-7	103.5	92.2	90 TARG	#2 Lift 1 NWC
T25			23.2	124.5	101.0	P-7	103.5	97.6	90 TARG	#2 Lift 1 Ncenter
T26			21.6	126.1	103.7	P-6	110	94.3	90 TARG	#1 Lift 3 NWC
T27			23.5	124.3	100.7	P-6	110	91.5	90 TARG	#1 Lift 3 SWC
T28			24.4	125.2	100.7	P-6	110	91.5	90 TARG	#1 Lift 3 SEC
T29			22.3	127.9	104.5	P-6	110	95.0	90 TARG	#1 LIFT 3 NEC
T30			12.5	122.6	109.0	P-8	122	89.3	95 TARG	#4, LIFT 1, NWC
T31			12.0	110.5	98.7	P-8	122	80.9	95 TARG	#4 Lift 1 SEC
T32			8.9	111.8	102.6	P-8	122	84.1	95 TARG	#4 Lift 1 NEC
T33			46.5	103.2	70.4					CLAY STOCKPILE
T34			18.5	127.9	107.9	P-6	110	98.1	90 TARG	#1 Lift 3 NWC
T35			20.0	123.9	103.2	P-6	110	93.8	90 TARG	#1 Lift 3 SWC
T36			21.5	125.4	103.2	P-6	110	93.8	90 TARG	#1 Lift 3 SEC
T37			20.8	122.9	101.7	P-6	110	92.5	90 TARG	#1 Lift 3 NEC
T38			12.8	110.8	98.2	P-8	122	80.5	95 TARG	#4 Lift 1 SEC

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

NEC: NORTH EAST CORNER

12-16% H_2O

Pioneer Technical Services, Inc. P.O. Box 3445 Butte, MT 59702 (406) 782-5177	**FIELD DENSITY TEST SUMMARY**	Project LAO/CLARK Project No. 4502 Tests on TEST PADS Page 3 of 3

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T39	5-3-2	NG	15.5	131.5	113.8	P-8/9	122.0	93.3	96 TARG	#4 lift 1 SEc
T40			15.4	132.5	115.9	P-8/9	122.0	95.0	95 TARG	#4 Lift 1 NEc
T41			15.8	130.9	113.0	P-8/9	122.0	92.6	95 TARG	#4 Lift 1 NWc
T42			14.2	133.2	116.6	P-8/9	122.0	95.6	95 TARG	#4 Lift 1 SWc
T43			14.2	132.8	116.3	P-8/9	122.0	95.3	95 TARG	#4 Lift 2 SEc 4Pass NoV
T44			10.5	129.2	116.9	P-8/9	122.0	95.8	95 TARG	#4 Lift 2 SWc "
T45			11.0	131.9	118.8	P-8/9	122.0	97.4	95 TARG	#4 LIFT 2 NWc "
T46			12.5	133.1	118.3	P-8/9	122.0	97.0	95 TARG	#4 LIFT 2 NEc "
T47			12.8	133.9	118.7	P-8/9	122.0	97.3	95 TARG	#4 LIFT 3 NWC, 4 PASSES
T48			13.3	133.4	117.8	P-8/9	122.0	96.6	95 TARG	#4, L3, NEC, "
T49			12.6	135.2	120.0	P-8/9	122.0	98.4	95 TARG	#4, L3, SEC, "
T50			13.6	132.2	116.4	P-8/9	122.0	95.4	95 TARG	#4, L3, SWC, 4"

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

95%=108.3, 90%=102.6   P5 → 90% = 85.1   95% = 89.8

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FIELD DENSITY TEST SUMMARY

Project LAO/CLARK
Project No. 4502
Tests on TEST PADS
Page 1 of 2

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T1	3-9-98	NG	29.2	118.2	91.5	P-4	97.5	93.8	90	#5 NE lift 1
T2			33.1	115.8	87.0	P-4	97.5	89.2	90	#5 SW lift 1
T3			30.5	117.1	89.7	P-4	97.5	92.0	90	#5 NW lift 1
T4			27.8	121.0	94.6	P-4	97.5	97.0	90	#5 SE lift 1
T5			28.5	118.2	92.0	P-4	97.5	94.4	90	#5 SE lift 2
T6			24.1	123.9	99.8	P-4	97.5	102.4	90	#5 NE lift 2
T7			27.33	119.1	93.8	P-4	97.5	100	90	#5 NW lift 2
T8			29.6	119.5	92.2	P-4	97.5	94.6	90	#5 SW LIFT 2
T7R			25.0	123.6	98.6	P-4	97.5	101.1	90	RETEST T7.
T9			27.7	120.9	94.7	P-4	97.5	97.1	90	#5 NW LIFT 3
T10			30.0	120.4	92.7	P-4	97.5	95.1	90	#5 SW LIFT 3
T11			27.8	120.6	94.4	P-4	97.5	96.8	90	#5 SE LIFT 3
T12			24.3	123.7	99.5	P-4	97.5	102.1	90	#5 NE lift 3
T13			15.4	125.4	108.6	P-18	114	95.3	90	#2 NE lift 1
T14			18.41	125.5	106.0	P-18	114	93.0	90	#2 SE lift 1
T15			14.2	125.6	110.0	P-18	114	96.5	90	#2 SW lift 1
T16			15.5	129.3	111.9	P-18	114	98.2	90	#2 NW lift 1
T17			24.5	125.7	100.9	P-18	114	88.5	90	#2 NE lift 2
T18			18.7	124.1	104.5	P-18	114	91.7	90	#2 SE lift 2
T19			15.4	127.3	110.4	P-18	114	96.8	90	#2 SW lift 2

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

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FIELD DENSITY TEST SUMMARY

Project LAO/CLARK
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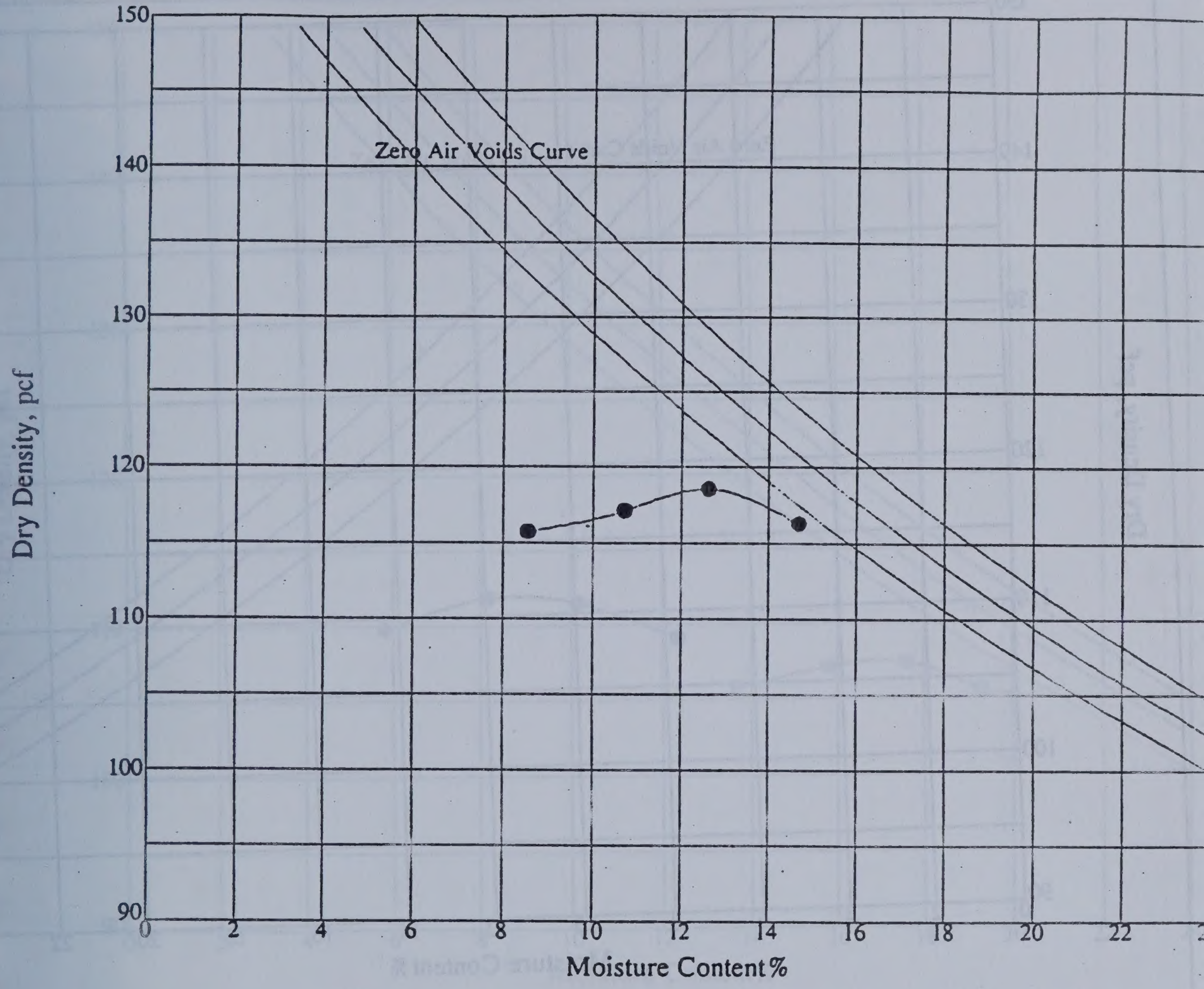
Tests on TEST PADS
Page 2 of 2

Test No.	Date Tested	Test Type*	Moisture Content (%)	Field Wet Density (pcf)	Field Dry Density (pcf)	Compaction Curve No.	Lab Maximum Dry Density (pcf)	Relative Compaction (%)	Specified Relative Compaction (%)	Comments
T20	7-9-96	NG	21.8	127.0	104.3	P-18	114	91.5	90	#2 NW Lift 2
T21			16.4	127.0	109.1	P-18	114	95.7	90	Retest T13
T22			21.7	128.6	105.6	P-18	114	92.6	90	Retest T19
T23			16.8	127.2	108.9	P-18	114	95.5	96	#2 NE Lift 3
T24			15.2	130.4	113.2	P-18	114	99.3	90	SE
T25			16.0	130.4	112.4	P-18	114	98.6	90	SW
T26	7-9-96		18.8	122.8	103.3	P-18	114	90.6	90	NW

* SC = Sandcone Density; NG = Nuclear Gauge Density Test

APPENDIX C

MOISTURE-DENSITY RELATIONSHIP CURVES



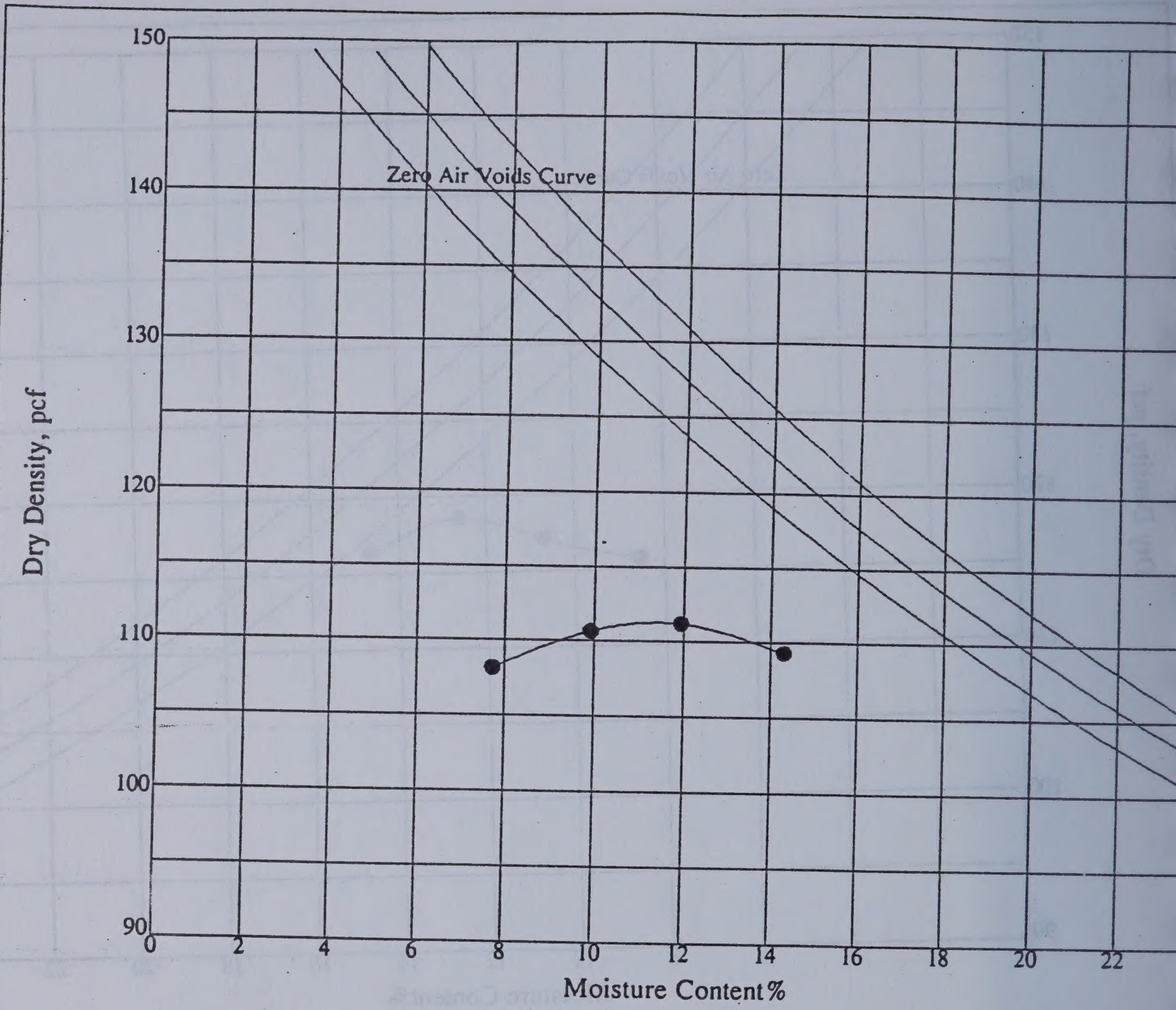
			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-Subgrade-1	Lab: 96238	Depth: Unknown	118.5	12.5

Soil Description: POORLY GRADED SAND, fine- to coarse- grained, nonplastic, dark brown. (SP)
10% aggregate retained on the #4 sieve (cumulative).
5% aggregate retained on the 3/8" sieve (discarded).
3% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from LAO Butte Reduction Works.

ASTM D 698-91
Procedure: B

*Density and moisture results rounded to nearest 0.5.

Job No: BJBX-96-057A Appr: BAW Date: JUN 27, 1996	Laboratory Compaction Characteristics of Soil (Proctor) LAO/Clark Butte, Montana Braun Intertec Corporation	Plate P-1



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-Tails-1	Lab: 96239	Depth: Unknown	111.0	11.5

Soil Description: SILTY SAND, fine- to coarse-grained, nonplastic, mine tailings, olive brown. (SM)

0% aggregate retained on the #4 sieve (discarded).

0% aggregate retained on the 3/8" sieve (discarded).

0% aggregate retained on the 3/4" sieve (discarded).

Sampled by BOA/PTS on 06/25/96 from LAO Test Pit No. 2.

(PRECON TAILINGS)

ASTM D 698-91

Procedure: A

*Density and moisture resul

rounded to nearest 0.5.

Job No:

BJBX-96-057A

Appr:

BAW

Date:

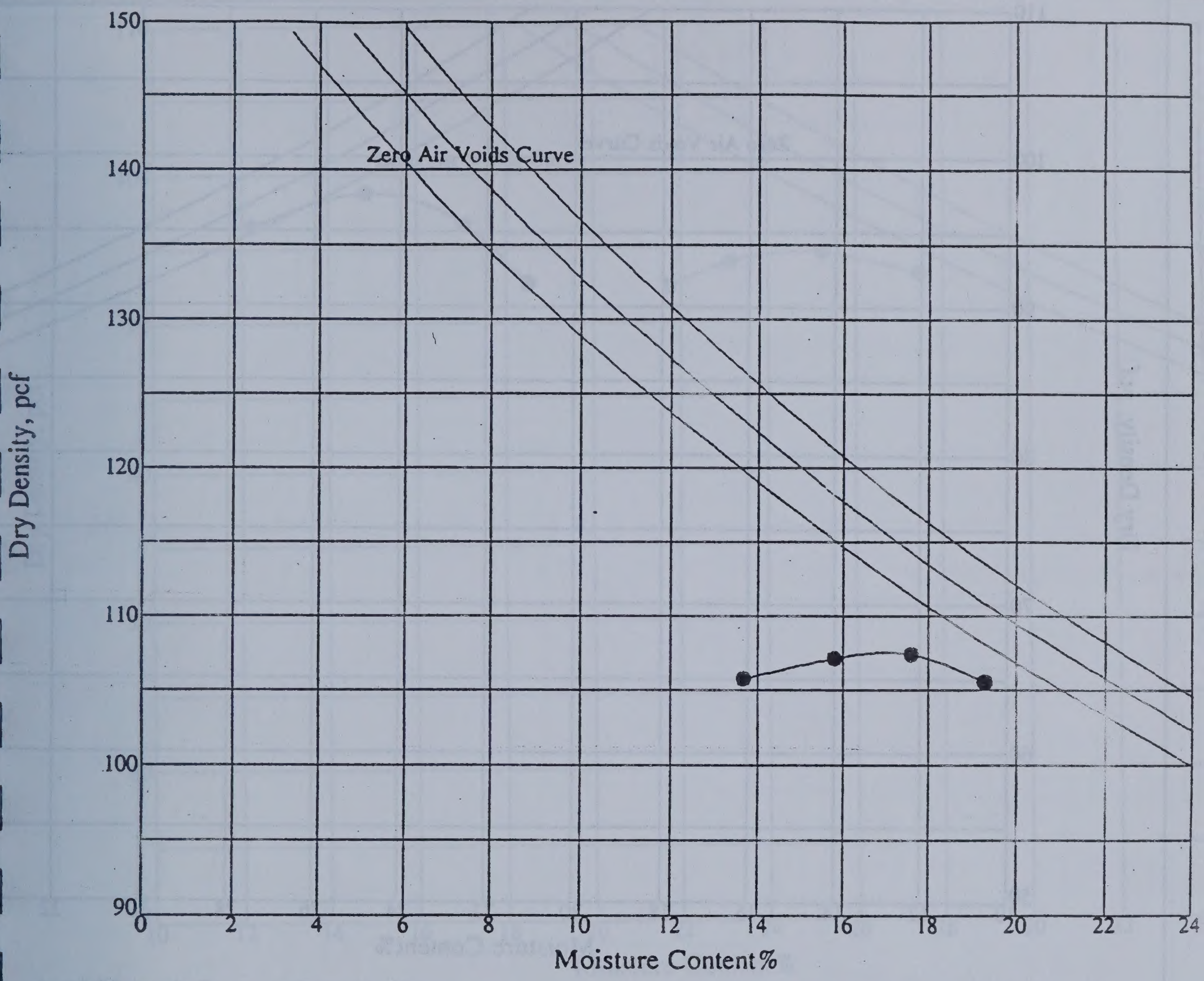
JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plat

P-



Sample No: CTTP-Tails-2	Lab: 96240	Depth: Unknown	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
			107.5	17.0

Soil Description: POORLY GRADED SAND, fine- to coarse-grained, nonplastic, brown. (SP)

2% aggregate retained on the #4 sieve (discarded).

0% aggregate retained on the 3/8" sieve (discarded).

0% aggregate retained on the 3/4" sieve (discarded).

Sampled by BOA/PTS on 06/25/96 from LAO Test Pit No. 1.

(PRECON TAILINGS)

ASTM D 698-91
Procedure: A

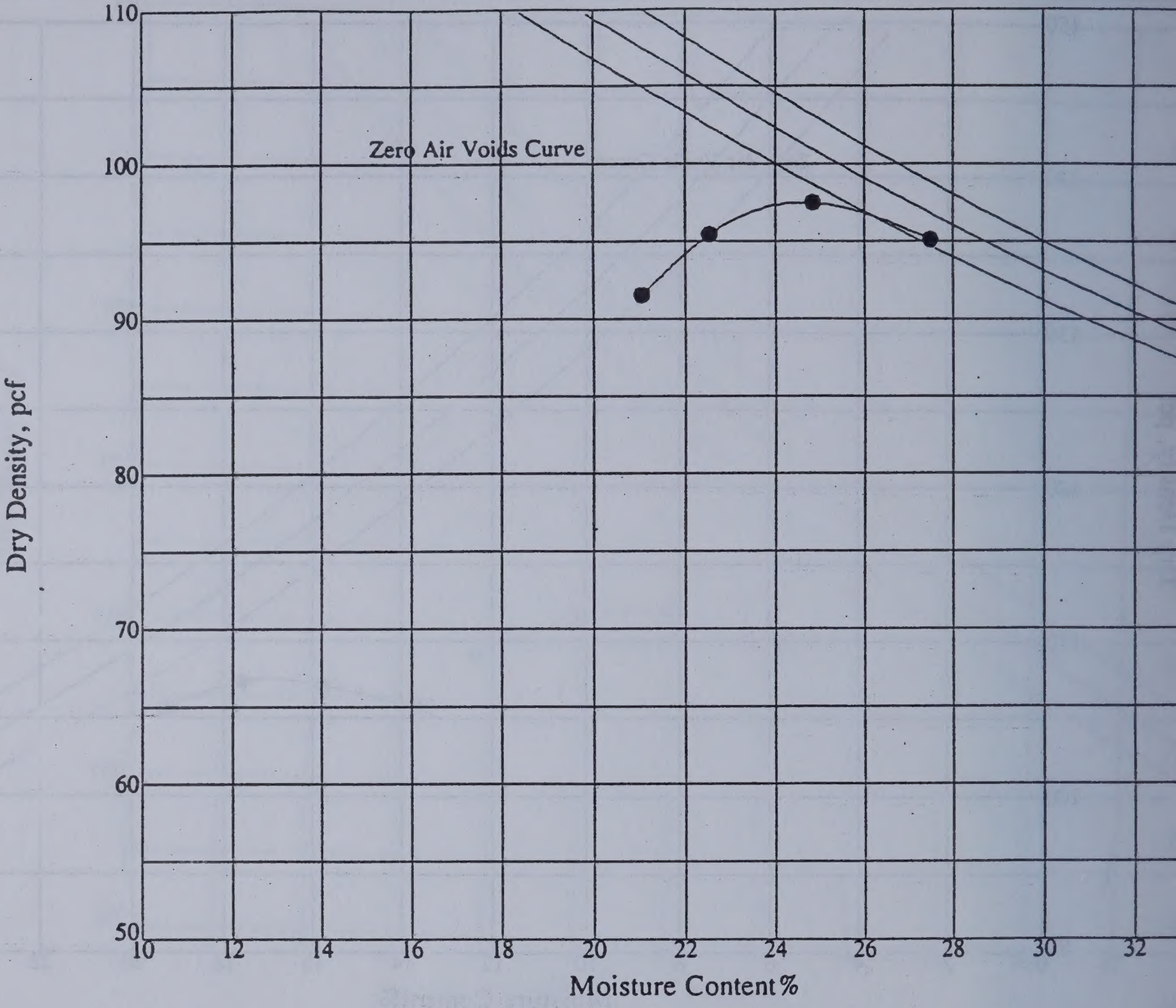
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-3



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-S/C-1	Lab: 96241	Depth: Unknown	97.5	25.0

Soil Description: SANDY LEAN CLAY, fine- to coarse-grained, low plasticity, trace organic, dark brown. (CL)

0% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from LAO Test Pit No. 2.

ASTM D 698-91
Procedure: A

CTTP5 PRECON.

*Density and moisture re
rounded to nearest 0.5.

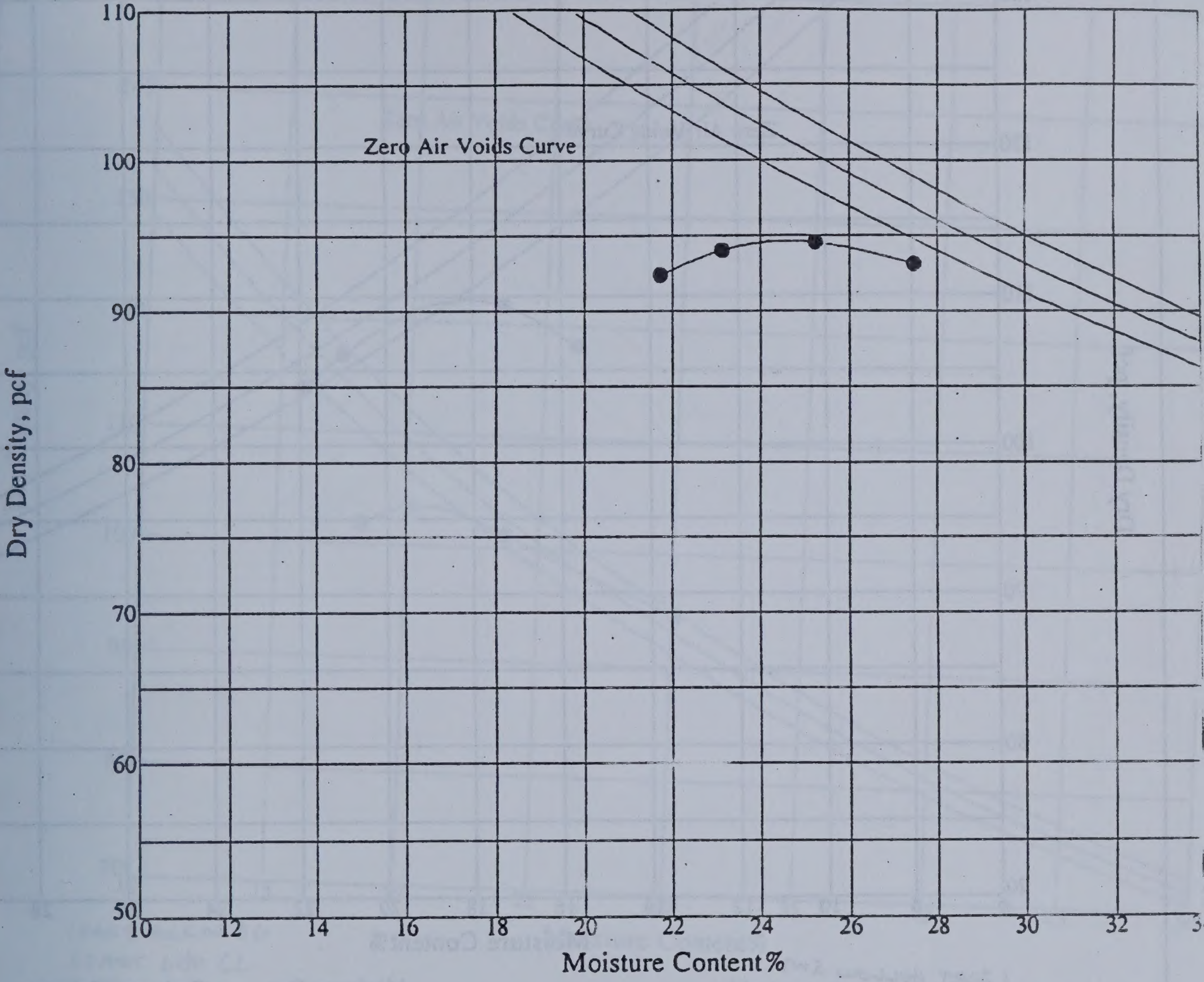
Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

P

P



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-S/C-2 Lab: 96242 Depth: Unknown	94.5	25.0

Soil Description: SANDY LEAN CLAY, fine- to coarse-grained, slightly plastic, trace organic, dark brown. (CL)
0% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from LAO Test Pit No. 1.

ASTM D 698-91
Procedure: A

CTTPS PRECON

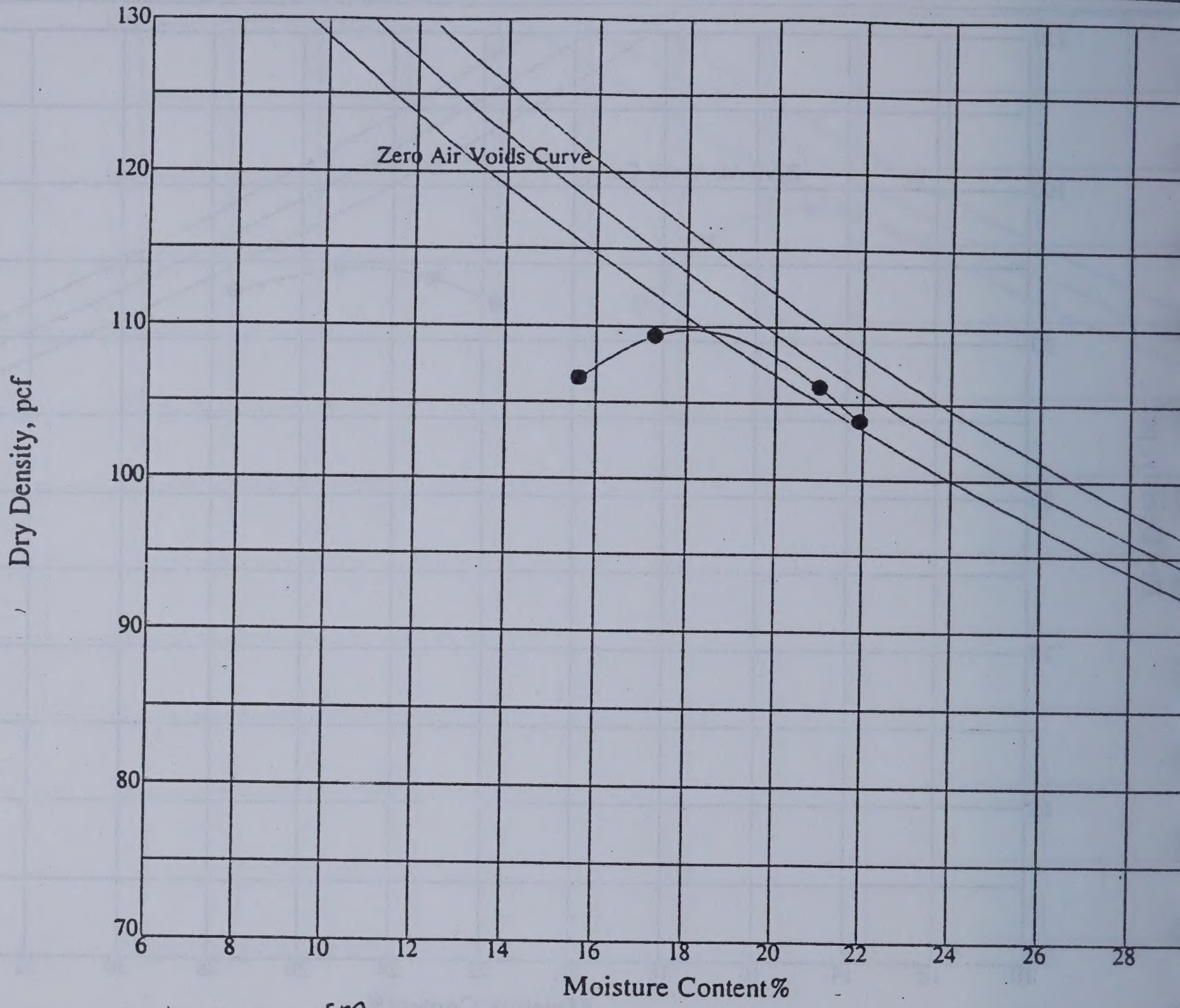
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUN 27, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-5



1 PART HOLLOW SM
1PART LAO CL

Maximum Dry Density Weight, pcf*: 110.0

Optimum Moisture Content %*: 18.0

Sample No: CTTP-1 Lab: 96253 Depth: Unknown

Soil Description: CLAYEY SAND, fine- to medium-grained, slightly to low pl., dark brown. (SC)
4% aggregate retained on the #4 sieve (discarded).
1% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/28/96 from LAO.

ASTM D 698-91
Procedure: A

CTTP1 PRECON

*Density and moisture resu
rounded to nearest 0.5.

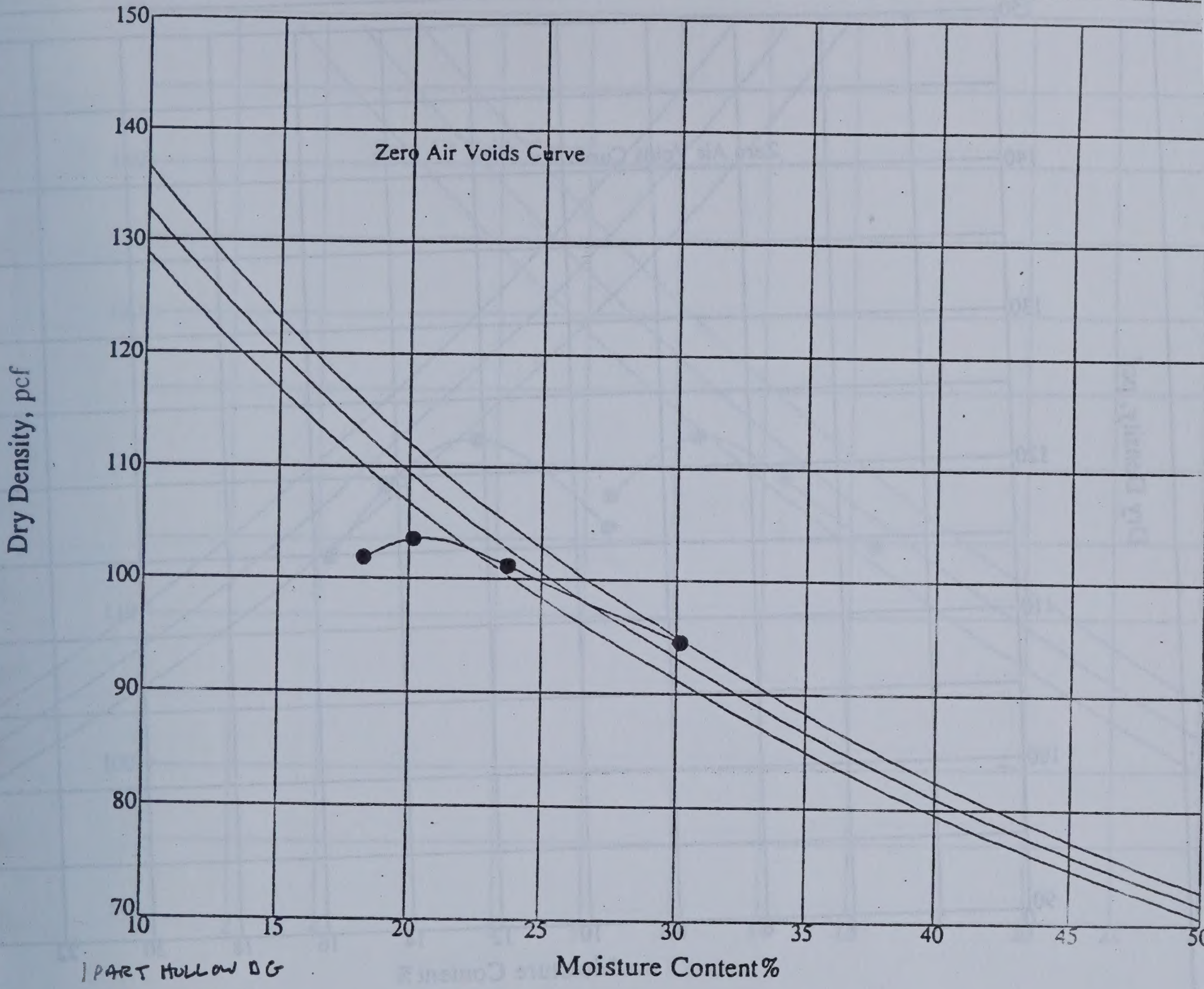
Job No:
BJBX-96-057A
Appr:
Date:
JUL 1, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Pla

P-



1 PART HOLLOW DG
3 PART LAO CL

			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: CTTP-2	Lab: 96254	Depth: Unknown	103.5	22.0

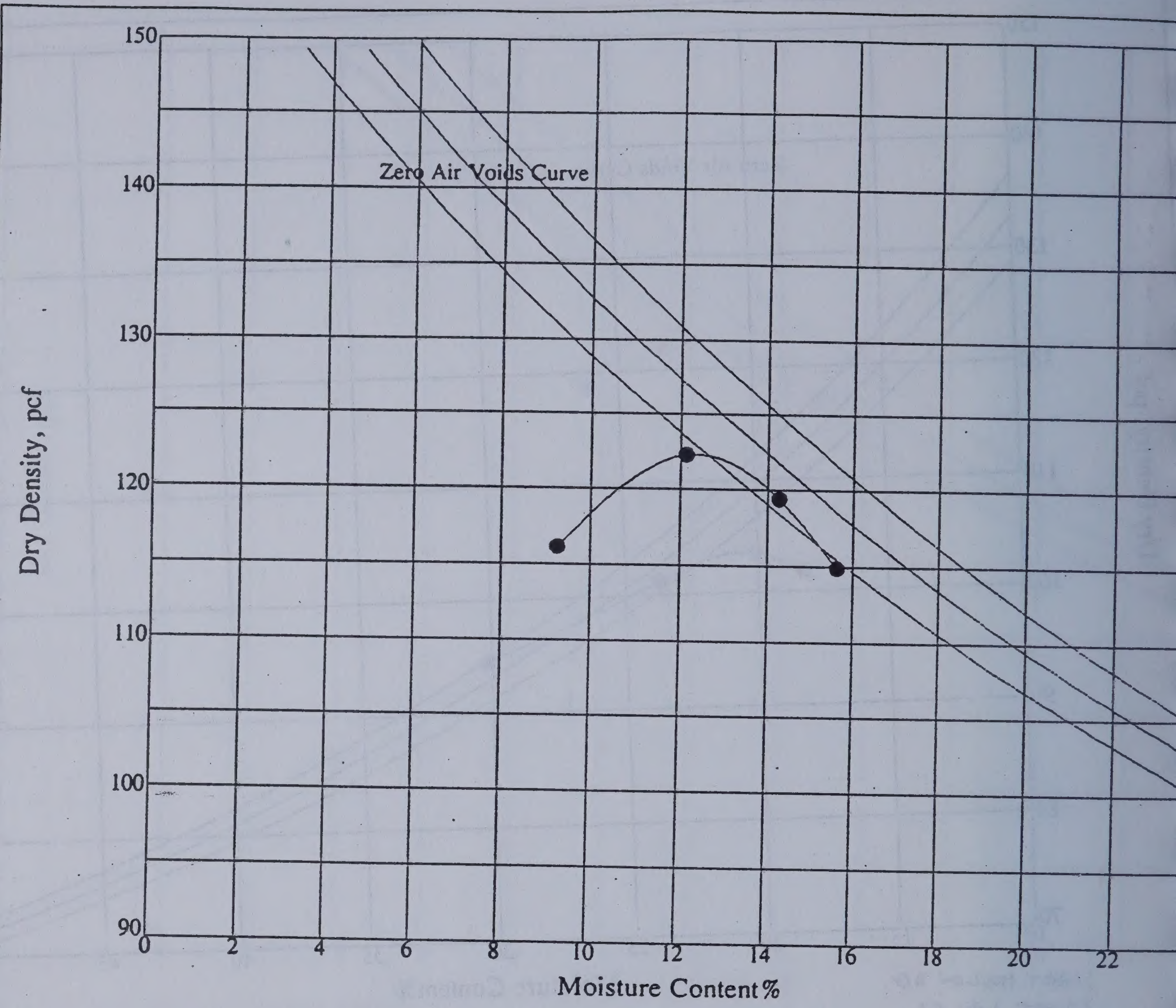
Soil Description: CLAYEY SAND, fine- to medium-grained, slightly to low pl., dark brown. (SC)
4% aggregate retained on the #4 sieve (discarded).
0.4% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/28/96 from LAO.

ASTM D 698-91
Procedure: A

CTTP2 PRECON (75% LAO, 25% DG)

*Density and moisture results rounded to nearest 0.5.

Job No: JBX-96-057A Appr: ate: JUL 1, 1996	Laboratory Compaction Characteristics of Soil (Proctor) LAO/Clark Butte, Montana Braun Intertec Corporation	Plate P-7



Sample No: Hollow Silty Sand - 1	Lab: 96255	Depth: Unknown	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
			122.0	12.5

Soil Description: CLAYEY SAND, fine- to coarse-grained, low plasticity, olive brown. (SC)
5% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 06/25/96 from Hollow Pit.

ASTM D 698-91
Procedure: A

CTTP4 PRECON

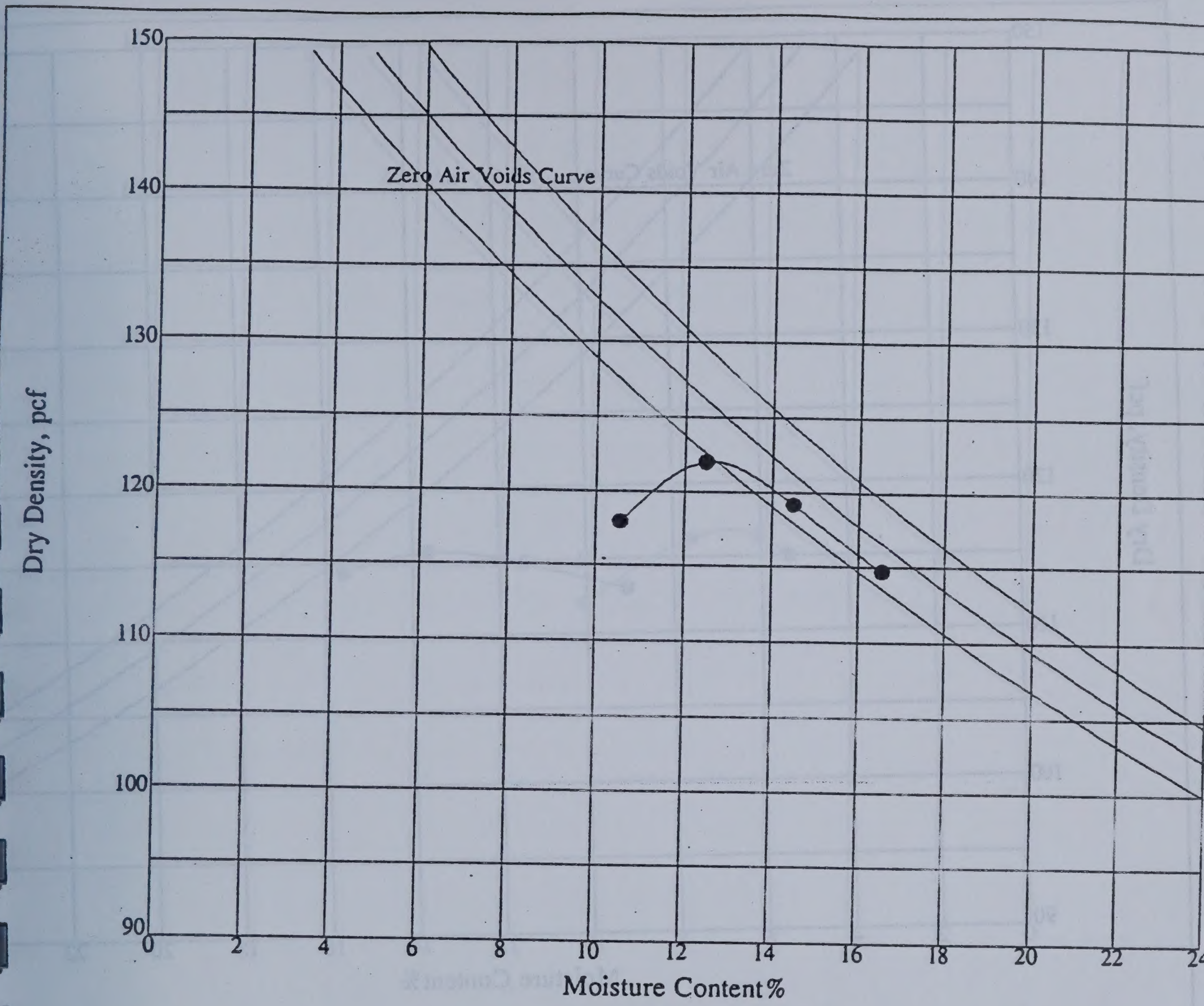
*Density and moisture results
rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
Date:
JUL 1, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-8



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 10 Lab: 96256 Depth: Inf. barrier layer	122.0	12.5

Soil Description: SILTY SAND, fine- to -coarse-grained, slightly plastic, reddish brown. (SM)
5% aggregate retained on the #4 sieve (discarded).
1% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by BOA/PTS on 07/01/96 from Hollow Pit, Silt sand-2

(CTTP# PRECON)

ASTM D 698-91
Procedure: A

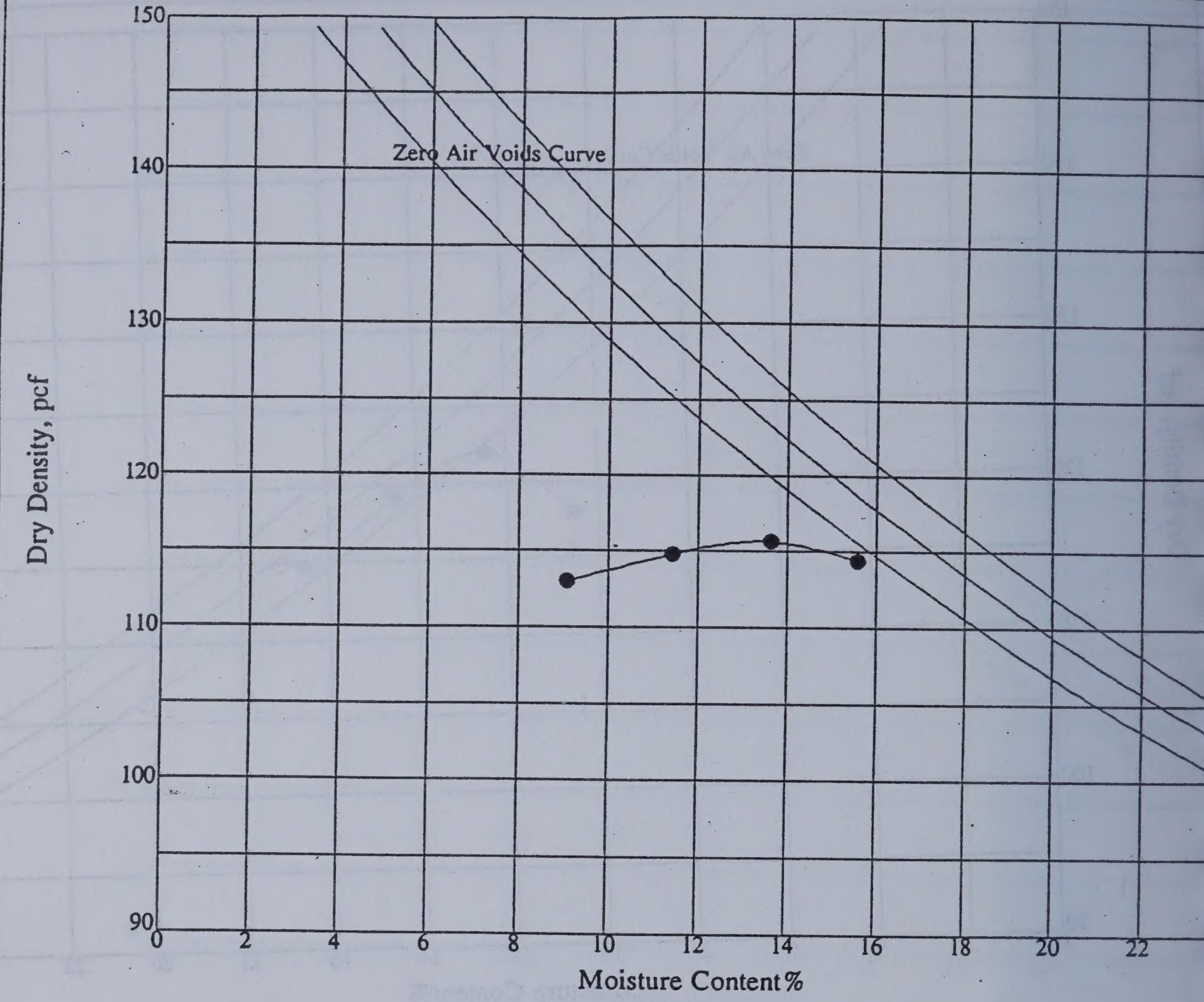
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
VFK
Date:
JUL 3, 1996

Laboratory Compaction Characteristics of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-9



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 15	Lab: 96265	Depth: 0 - 12"	116.0	13.5

Soil Description: SILTY SAND, fine- to medium-grained, nonplastic, dark brown.
(SM)
2% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-4. - TAILINGS

ASTM D 698-91
Procedure: A

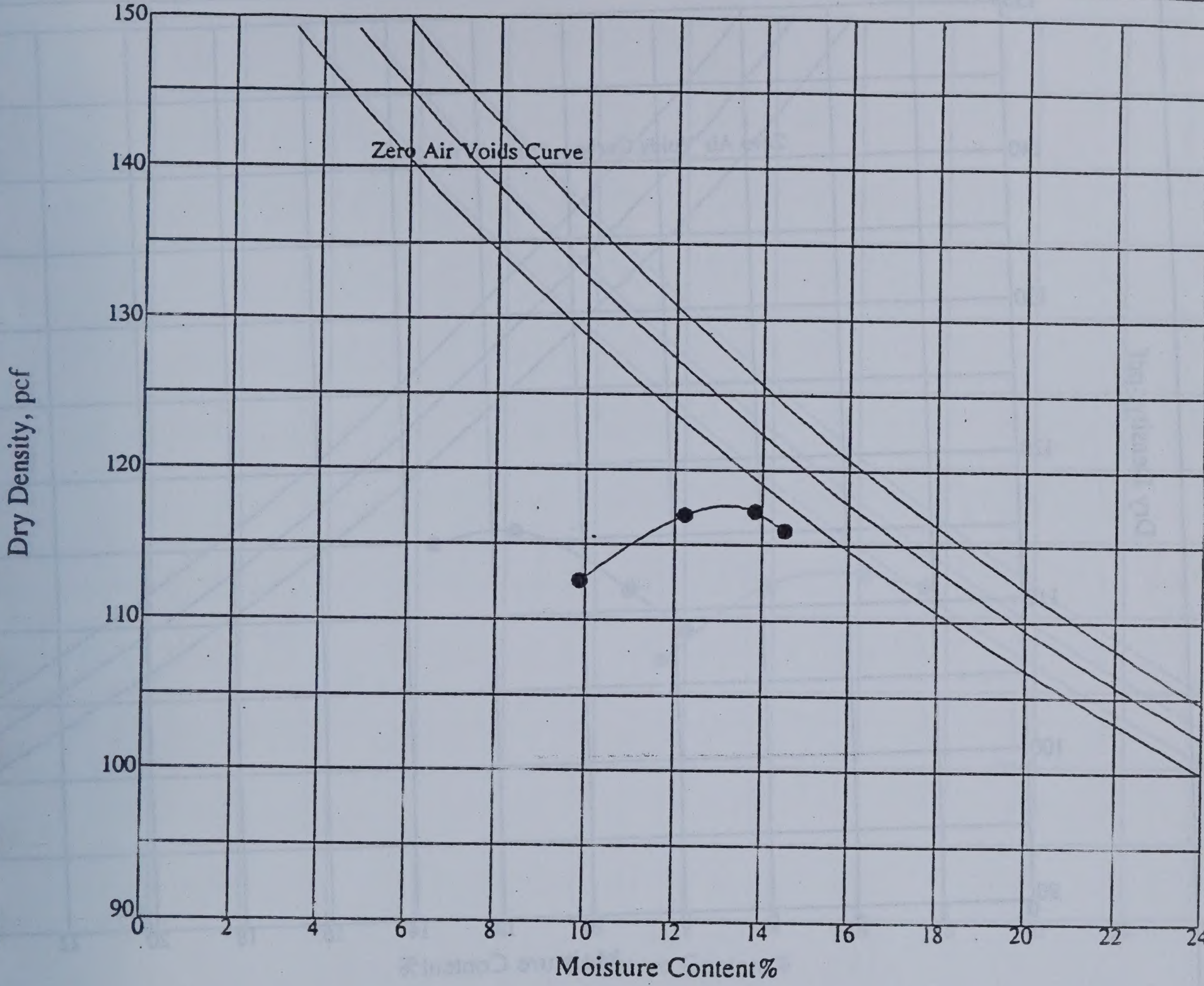
*Density and moisture result
rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 9, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plat
P-1



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 16 Lab: 96266 Depth: 0 - 12"	117.5	13.0

Soil Description: SILTY SAND, fine- to medium-grained, nonplastic, brown. (SM)

2% aggregate retained on the #4 sieve (discarded).
0.3% aggregate retained on the 3/8" sieve (discarded).
0.2% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-2 - TAILINGS

ASTM D 698-91
Procedure: A

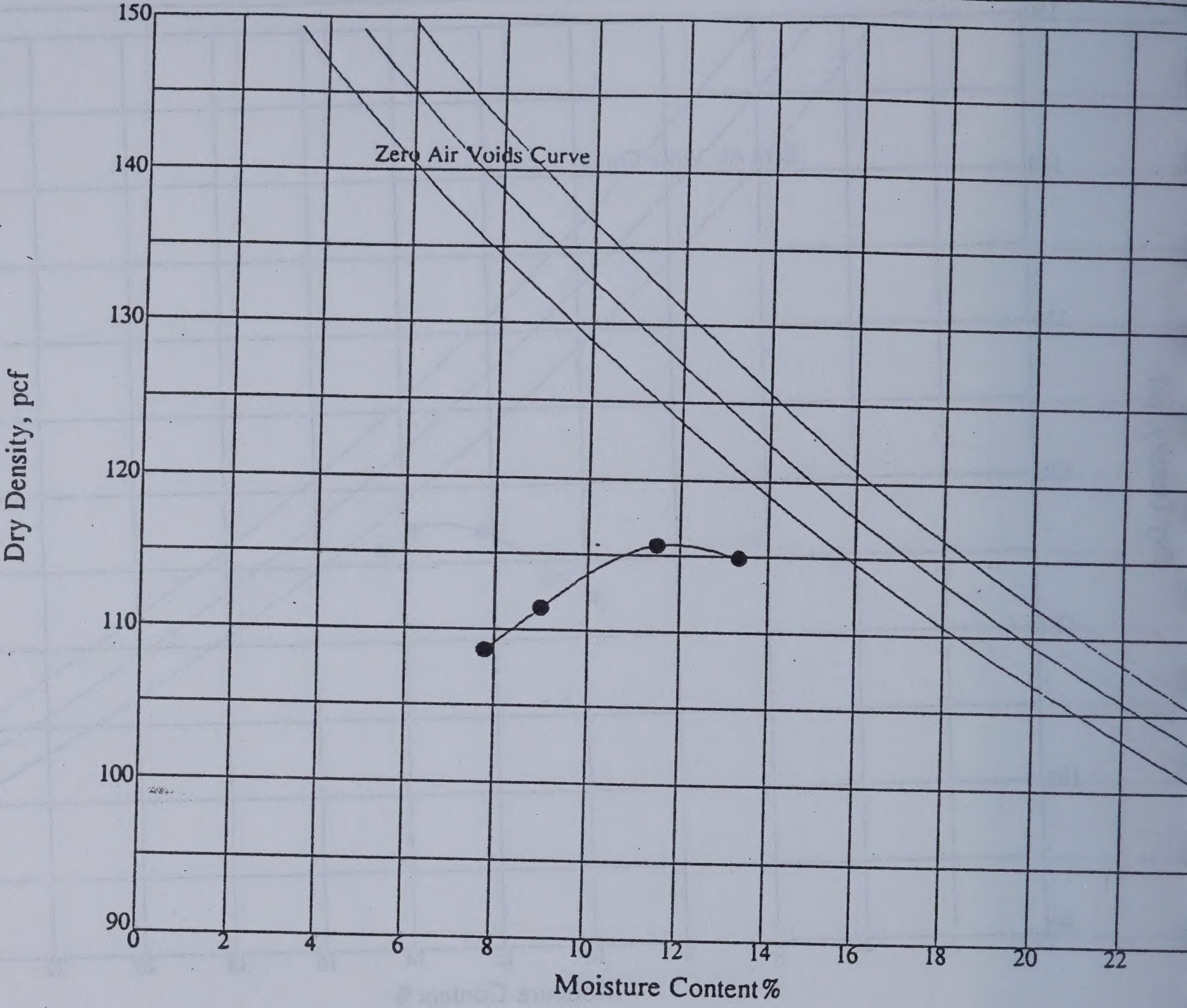
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr: WFK
Date:
JUL 8, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-11



Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
116.0	12.0

Sample No: 17 Lab: 96267 Depth: 0 - 12"

Soil Description: SILTY SAND, fine- to medium-grained, nonplastic, olive brown. (SM)

0.2% aggregate retained on the #4 sieve (discarded).
0% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-1. TAILINGS

ASTM D 698-91
Procedure: A

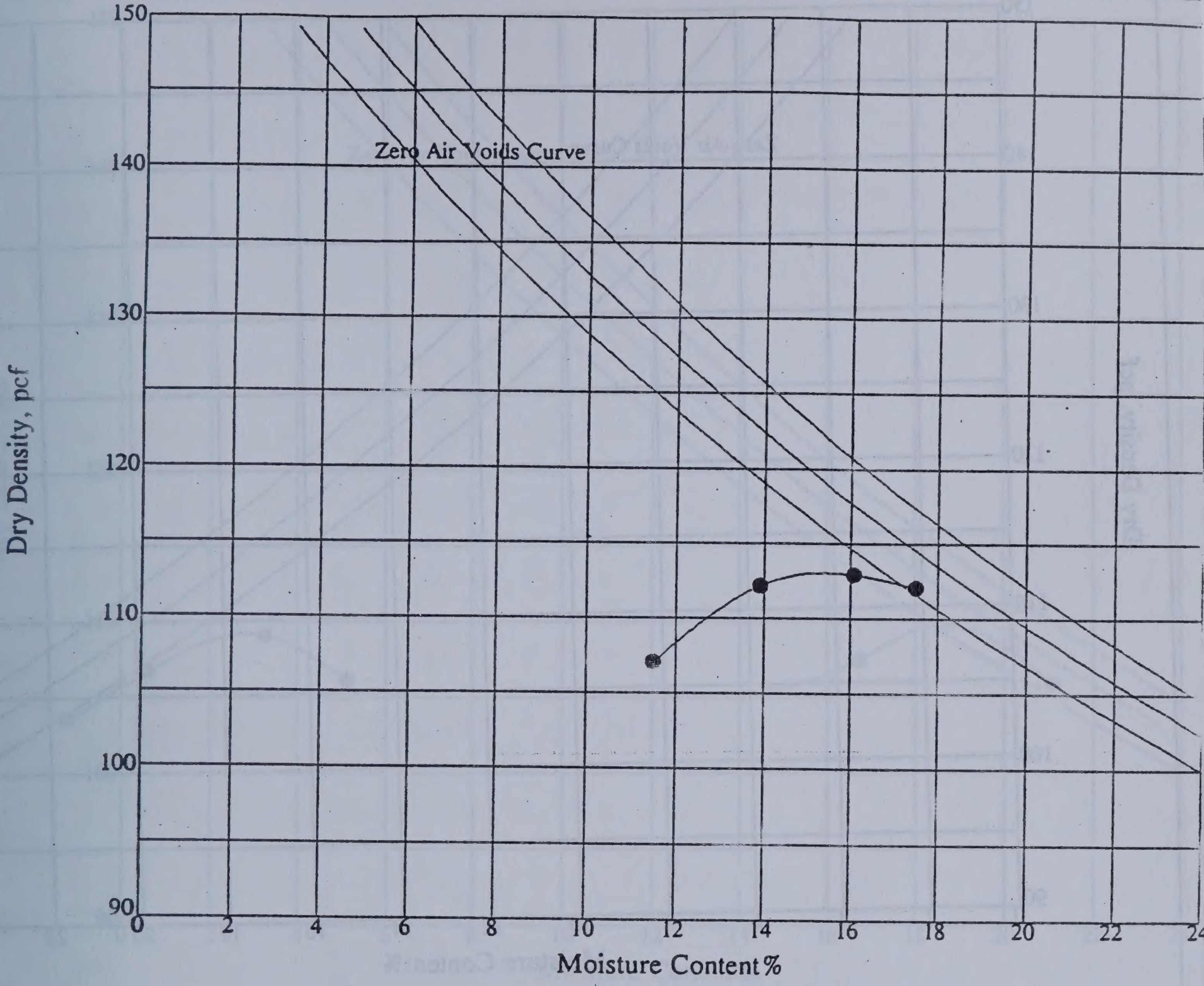
*Density and moisture results
rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 5, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-12



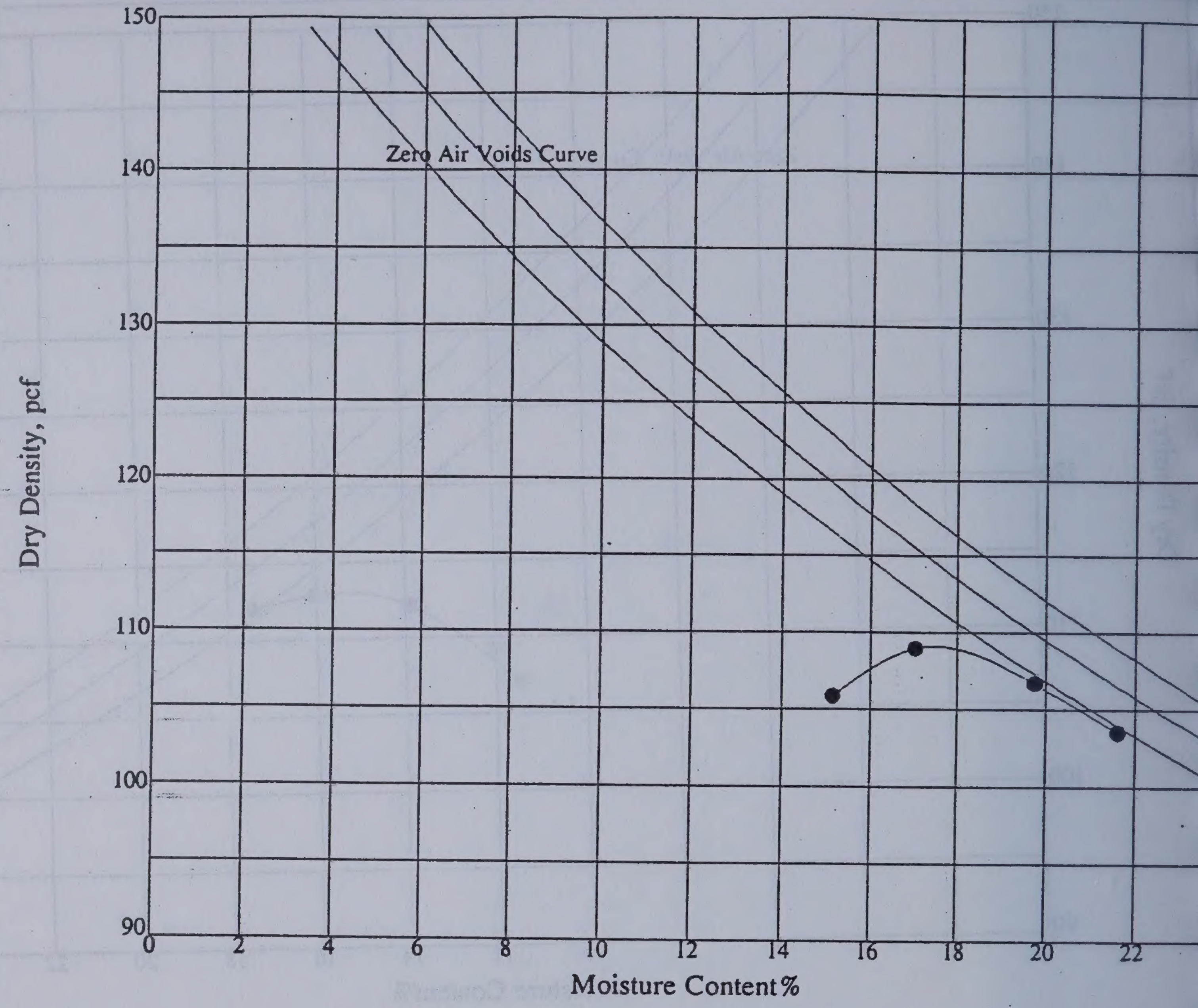
			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 18	Lab: 96268	Depth: 0 - 6"	113.0	15.5

Soil Description: SILTY SAND, fine- to medium-grained, slightly plastic, dark brown. (SM)
4.5% aggregate retained on the #4 sieve (discarded).
1.3% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-1. LIFT 1

ASTM D 698-91
Procedure: A

*Density and moisture results rounded to nearest 0.5.

Job No: BJEX-96-057A	Laboratory Compaction Characteristics of Soil (Proctor) LAO/Clark Butte, Montana	Plate
Appr: BAW		
Date: JUL 9, 1996	Braun Intertec Corporation	P-13



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 19 Lab: 96269 Depth: 0 - 6"	109.0	17.5

Soil Description:

SILTY SAND, fine- to medium grained, slightly plastic, dark brown. (SM)
5.5% aggregate retained on the #4 sieve (discarded).
0.8% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07/02/96 from CT-TP-2. 75% LAO, 25% DG

ASTM D 698-91
Procedure: A

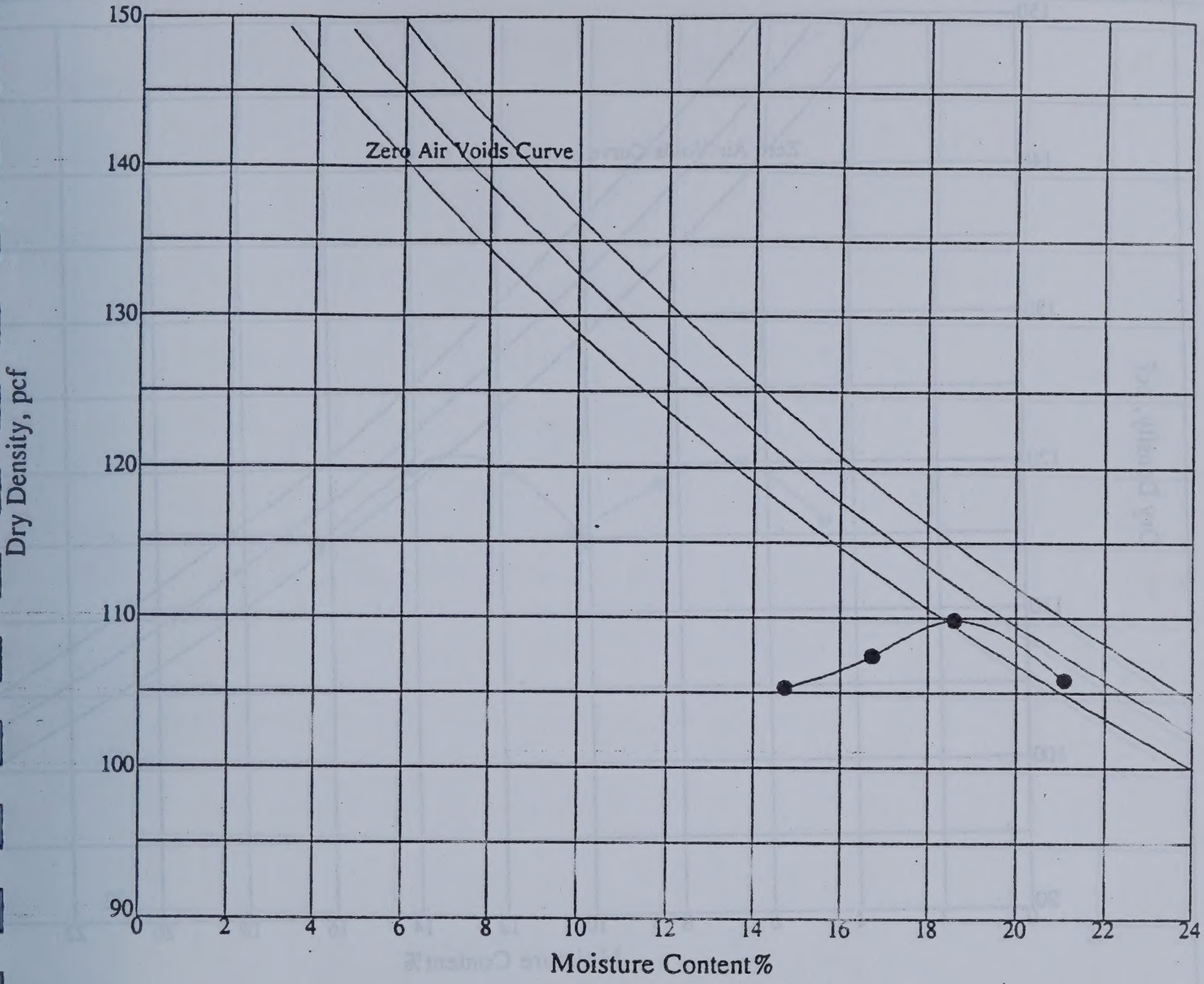
*Density and moisture result
rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 9, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plat
P-1



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 24 Lab: 96280 Depth: Lift 2	109.5	18.5

Soil Description: CLAYEY SAND, fine- to coarse-grained, medium plasticity, dark brown (SC).
3% aggregate retained on the #4 sieve (discarded).
1% aggregate retained on the 3/8" sieve (discarded).
0% retained on the 3/4" sieve.
Sampled by BOA/PTS on 73/96 from CTTP1, Lift 2.

ASTM D 698-91
Procedure: A

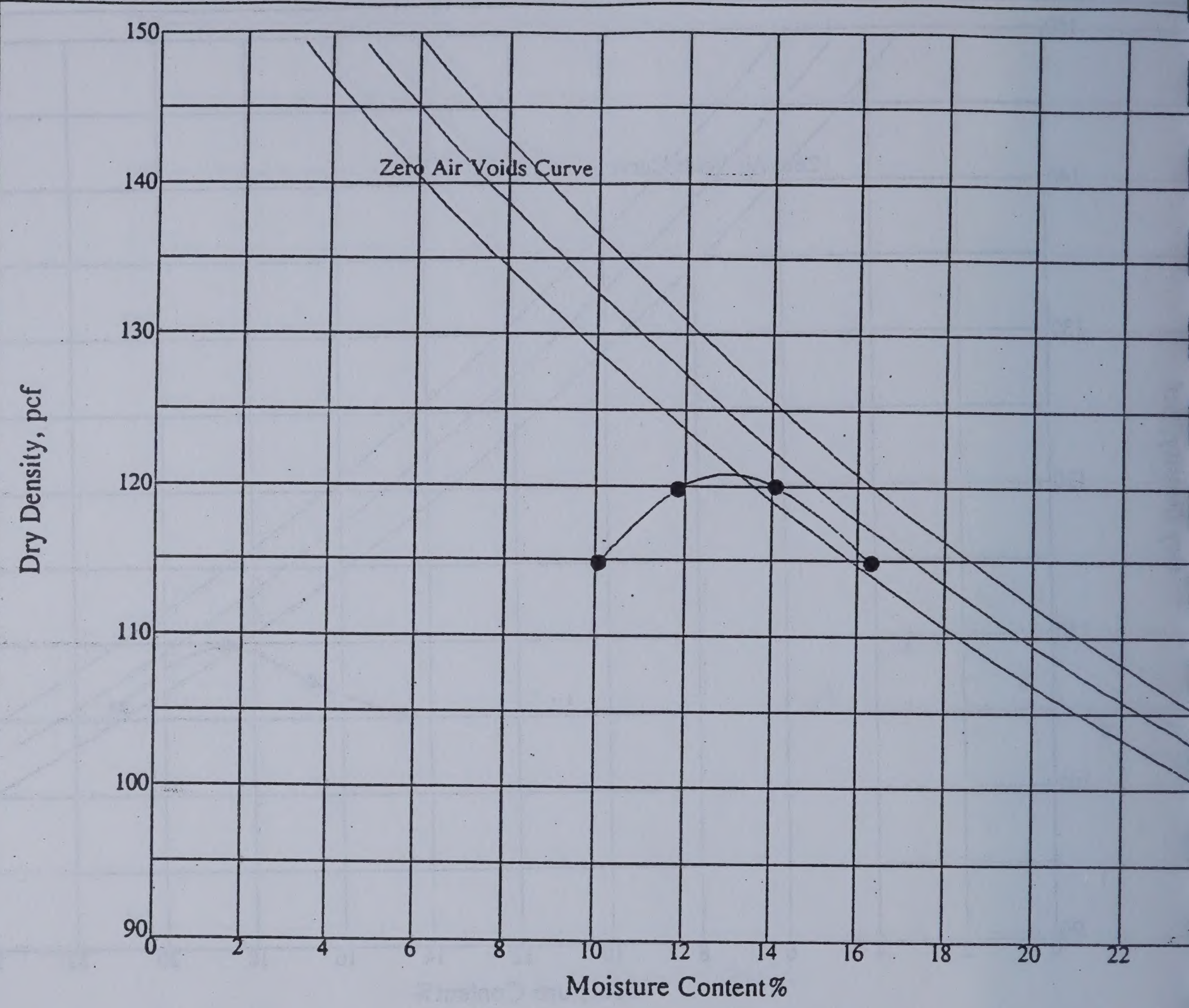
*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
Date:
JUL 12, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-15



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 25 Lab: 96281 Depth: ~~Lift 2~~	120.0	13.0

Soil Description: SILTY CLAYEY SAND, fine- to coarse-grained, low plasticity, light brown (SC-SM).
2% aggregate retained on the #4 sieve (discarded).
0.1% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve.
Sampled by BOA/PTS on 7/3/96 from CTTP4, Lift 3.

ASTM D 698-91
Procedure: A

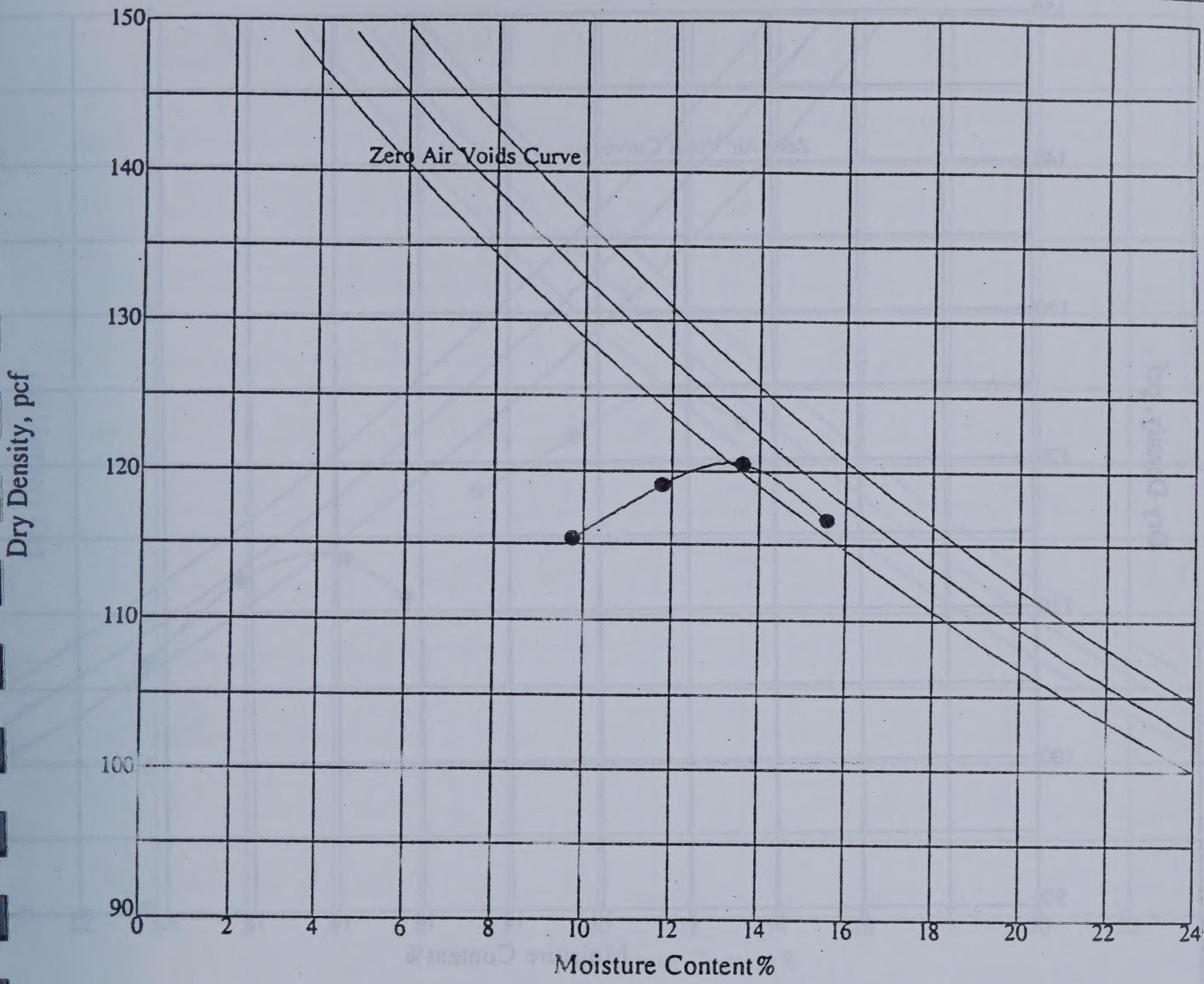
*Density and moisture result
rounded to nearest 0.5.

Job No:
BJEX-96-057A
Appr:
Date:
JUL 12, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-1



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 26	Lab: 96282	Depth: Lift 2	120.5	13.5

oil Description: CLAYEY SAND, fine- to coarse-grained, low plasticity, brown (SC).
3% aggregate retained on the #4 sieve (discarded).
0.3% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve.
Sampled by BOA/PTS on 7/3/96 from CTTP4, Lift 2.

STM D 698-91
Procedure: A

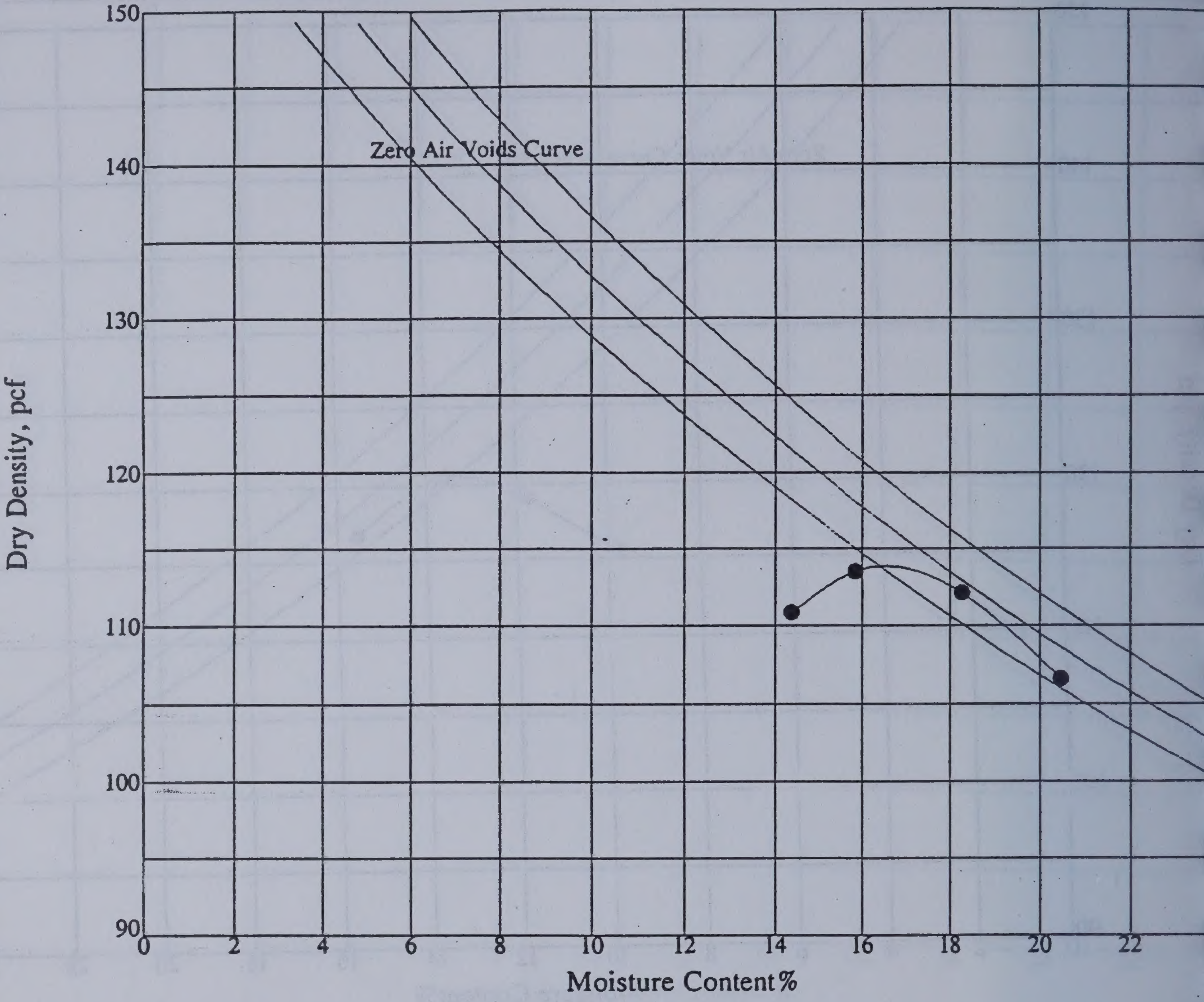
*Density and moisture results rounded to nearest 0.5.

ob No:
BX-96-057A
Appr:
ate:
JUL 12, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-17



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 27 Lab: 96283 Depth: Not Available (NA)	114.0	16.5

Soil Description: CLAYEY SAND, fine- to coarse-grained, slightly to low pl.,
black. (SC)
9% aggregate retained on the #4 sieve (cumulative).
3% aggregate retained on the 3/8" sieve (discarded).
2% aggregate retained on the 3/4" sieve (discarded). DEC. GRANITE
Sampled by DS/ARCO on 07/08/96, 50% Hollow and 50% LAO -CTTP2 PRECON.

ASTM D 698-91
Procedure: B

*Density and moisture result
rounded to nearest 0.5.

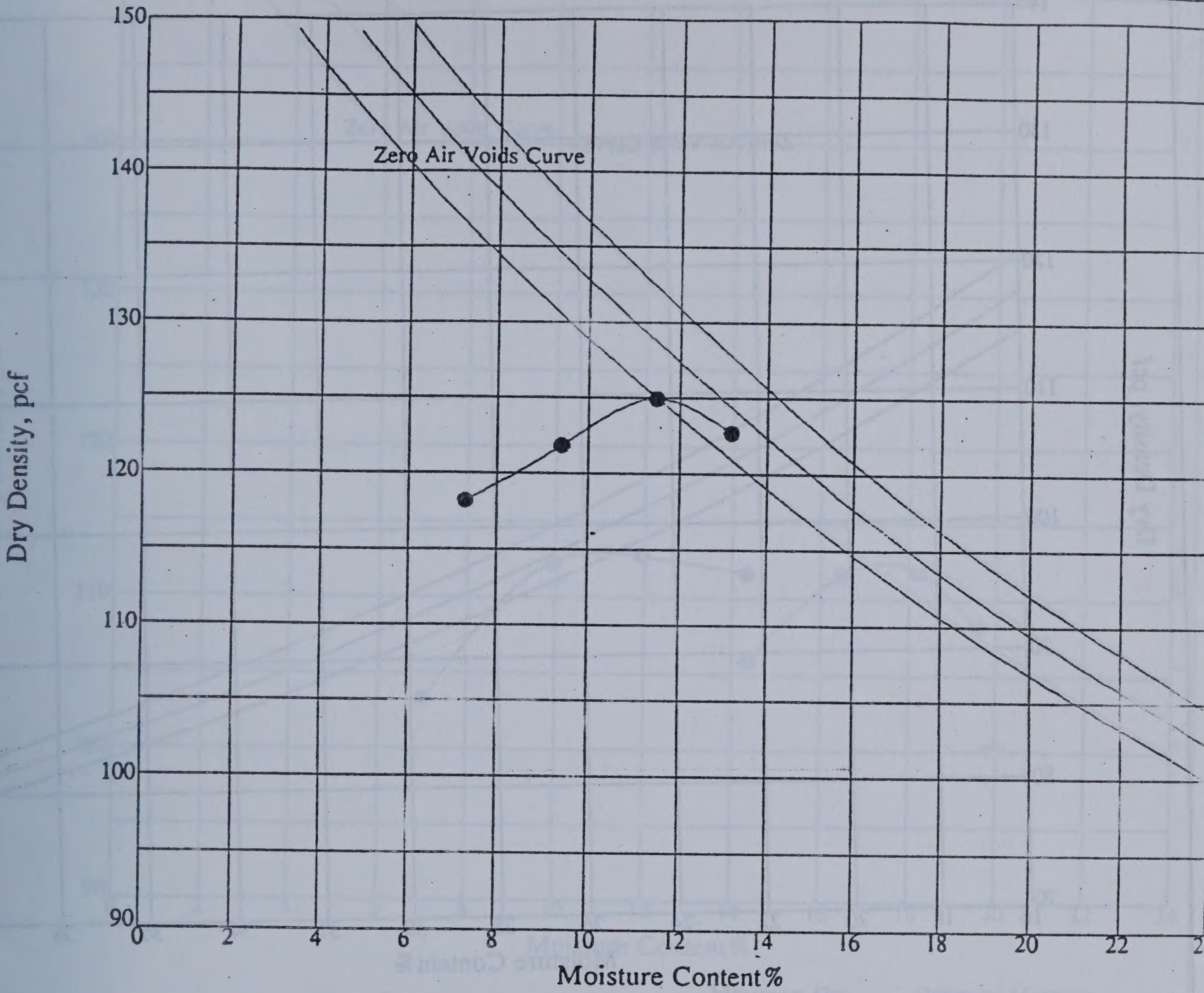
Job No:
BJBX-96-057A
Appr:
BAW
Date:
JUL 9, 1996

Laboratory Compaction Characteristics of Soil (Proctor)

LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plat
P-1



Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
125.0	11.5

Sample No: 28 **Lab:** 96310 **Depth:** Stockpile

Soil Description: POORLY GRADED SAND w/GRAVEL, fine- to coarse-grained, slightly plastic, brown. (SP)

15% aggregate retained on the #4 sieve (cumulative).

8% aggregate retained on the 3/8" sieve (cumulative).

2.7% aggregare retained on the 3/4" sieve (discarded).

Sampled by BOA & PJS/PTS on 07-17-96 on Chamber stockpile.

ASTM D 698-91

Procedure: C

*Density and moisture results rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
JMJ
Date:
JUL 18, 1996

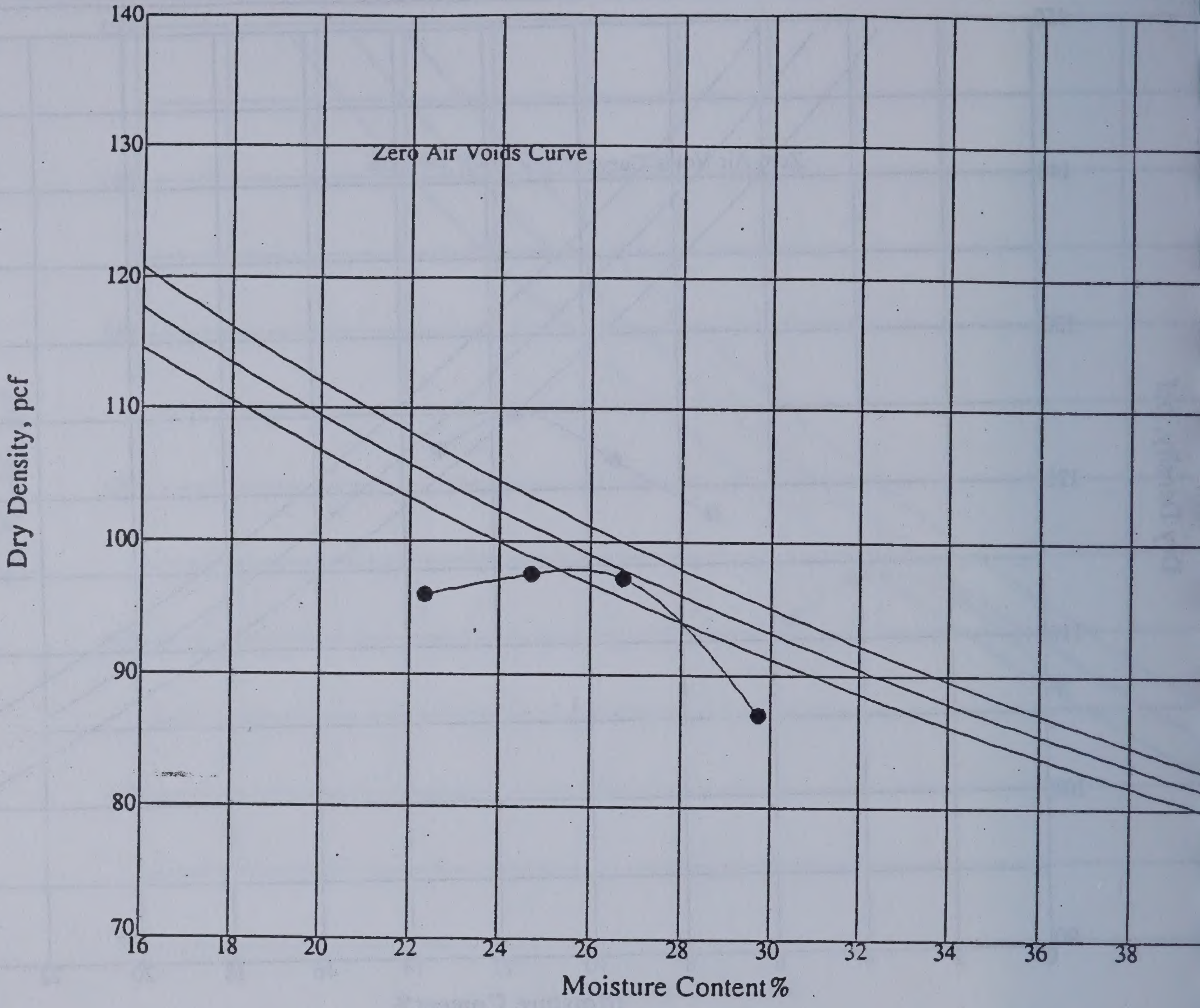
Laboratory Compaction Characteristics of Soil (Proctor)

LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate

P-19



	Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 29 Lab: 96320 Depth: Lift 2	98.0	25.5

Soil Description: SANDY SILT, fine- to coarse-grained, slightly plastic, brown. (ML)
5% aggregate retained on the #4 sieve (discarded).
4% aggregate retained on the 3/8" sieve (discarded).
3% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07-09-96 on CTTP5-Lift 2

ASTM D 698-91
Procedure: A

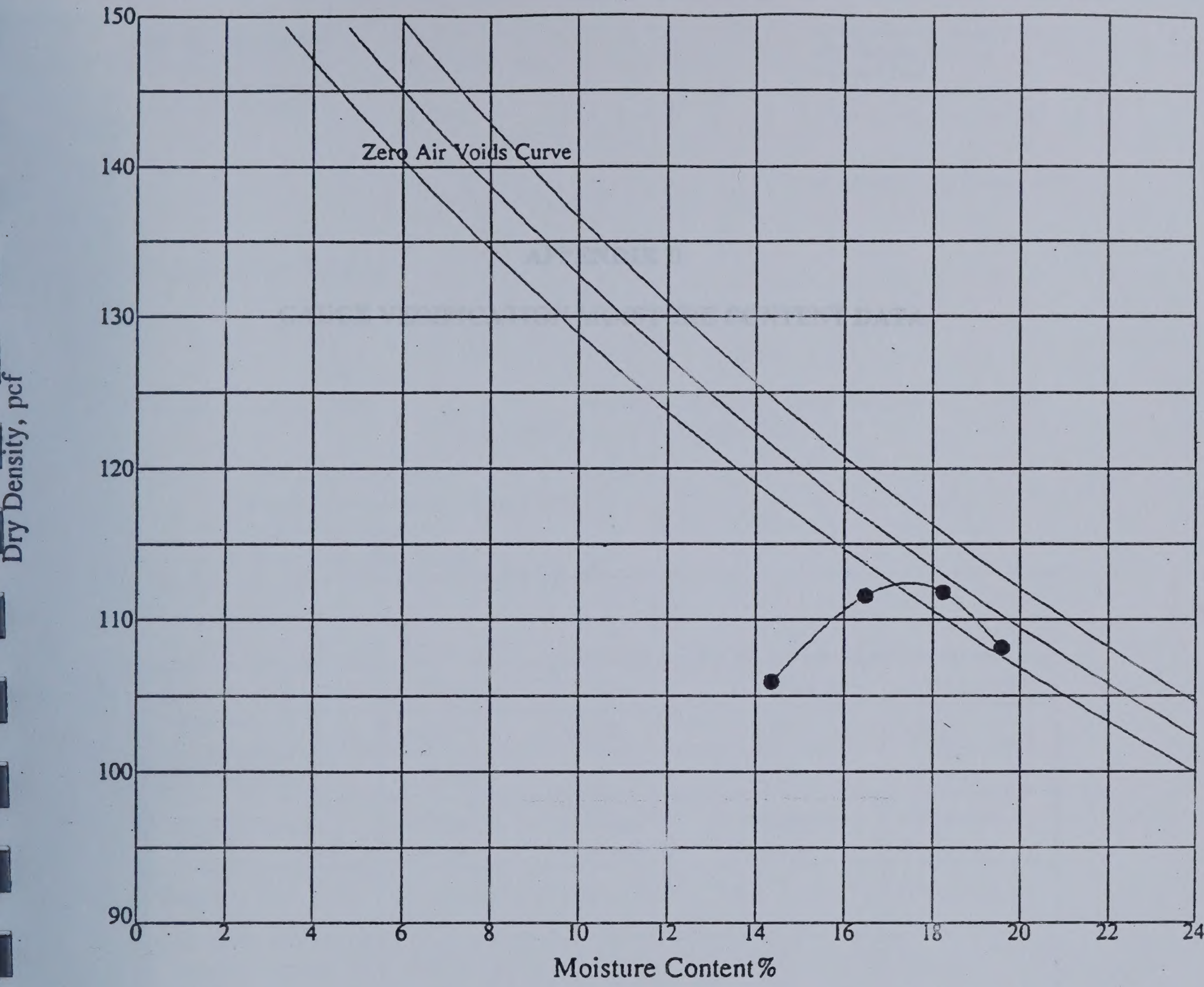
*Density and moisture results
rounded to nearest 0.5.

Job No:
BJBX-96-057A
Appr:
Brad Welch
Date:
JUL 26, 1996

Laboratory Compaction Characteristics
of Soil (Proctor)
LAO/Clark
Butte, Montana

Braun Intertec Corporation

Plate
P-2



			Maximum Dry Density Weight, pcf*	Optimum Moisture Content %*
Sample No: 30	Lab: 96321	Depth: Lift 1	112.5	17.5

oil Description: SILTY SAND, fine- to coarse-grained, slighty plastic, brown.
(SM).
8% aggregate retained on the #4 sieve (cumulative).
0.4% aggregate retained on the 3/8" sieve (discarded).
0% aggregate retained on the 3/4" sieve (discarded).
Sampled by PJS/PTS on 07-09-96 on CTTP2-Lift 1

STM D 698-91
ocedure: B

*Density and moisture results rounded to nearest 0.5.

ob No: BX-96-057A ppr: BAW te: UL 26, 1996	Laboratory Compaction Characteristics of Soil (Proctor) LAO/Clark Butte, Montana Braun Intertec Corporation	Plate P-21

APPENDIX D

GAUGE VERIFICATION MOISTURE CONTENT DATA

BRAUN℠
INTERTEC

Braun Intertec Corporation
1911 Meadowlark Lane
P.O. Box 3026
Butte, Montana 59702-3026
406-494-1675 Fax: 494-1678

Engineers and Scientists Serving the Built and Natural Environments®

Laboratory Testing

Date: July 8, 1996

Project: BJBX-96-057A Laboratory Testing
LAO/Clark

To: Mr. Brad Archibald
Pioneer Technical Services
105 North Excelsior
Butte, Montana 59701

Copies:

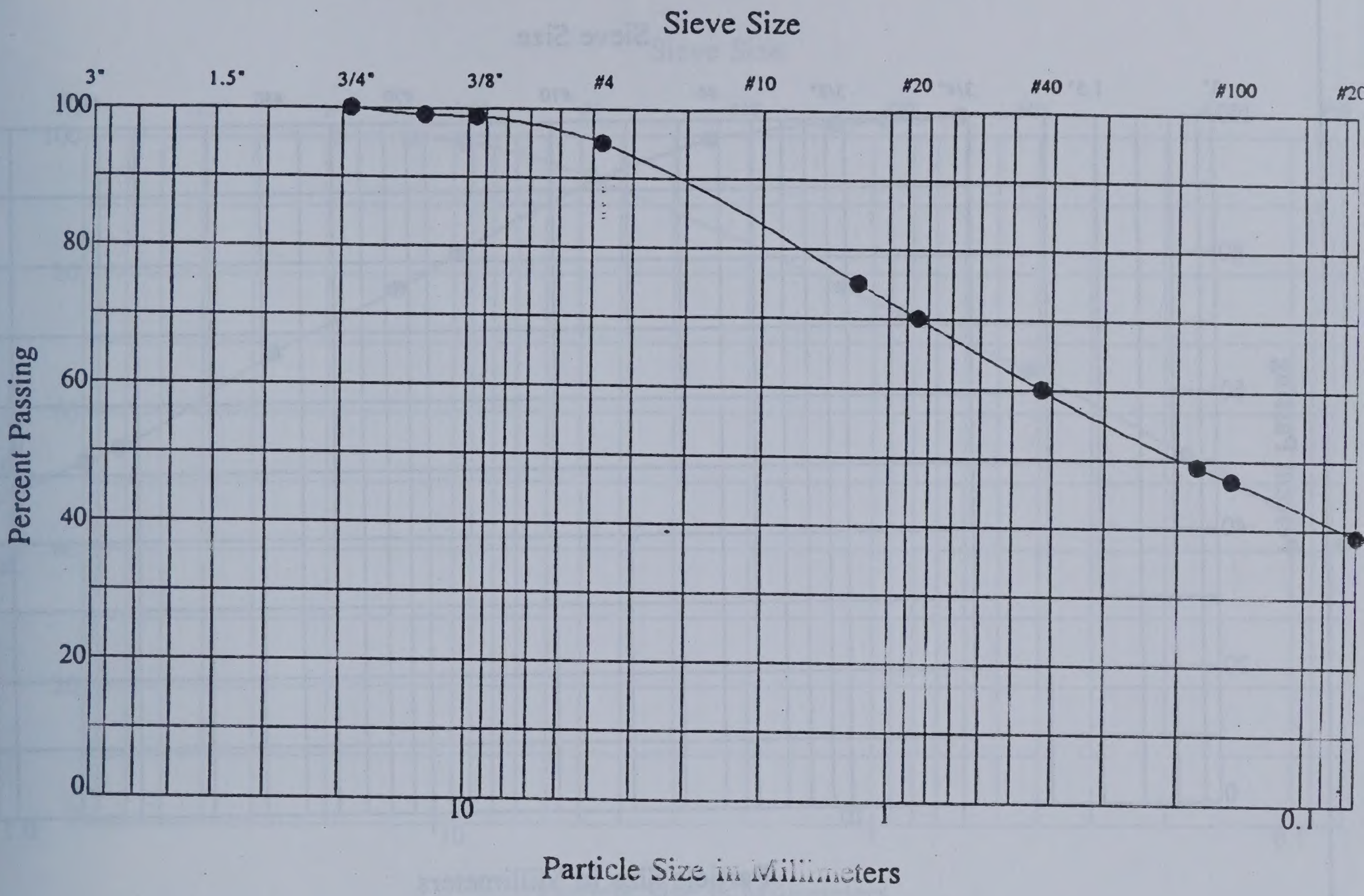
Sample	**Field**	CTTP4-T40	CTTP4-T42	CTTP4-T44	CTTP4-T46
	Lab	96273	96274	96275	96276
Date Sampled		07/03/96	07/03/96	07/03/96	07/03/96
Proposed Use		Informative Analysis	Informative Analysis	Informative Analysis	Informative Analysis
Depth		Not Available (NA)	NA	NA	NA
Moisture content, % ASTM D 2216		14.8	15.0	12.2	12.1

Lowell F. Klocke, CET
Manager, Butte Operations

APPENDIX E

INFILTRATION BARRIER LAYER MATERIALS INDEX PROPERTIES DATA

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	99	95	83	70	60	55	47	38.9

Sample No.: 18 Lab: 96268 Depth: 0' - 6'
Location: CTTP1 - LIFT1

Percent Gravel: 5.0
Percent Sand: 56.1
Percent Silt + Clay: 38.9

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 30.0
Plastic Limit: 25.8
Plasticity Index: 4.2
Classification: SM
Moisture Content = NT

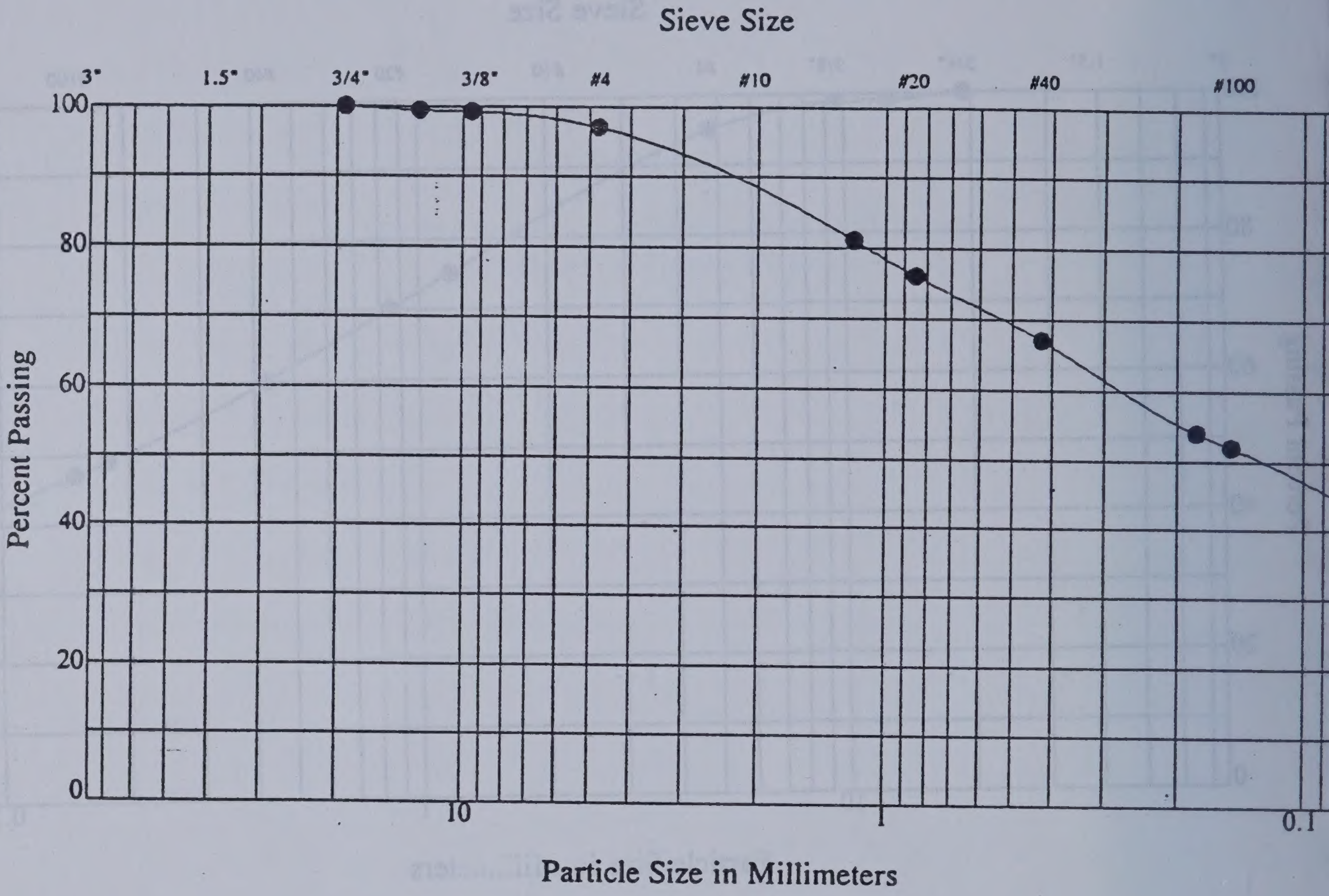
July 9, 1996

LAO/Clark - Butte, Montana

Braun Intertec Corporation

Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#20
100	100	99	97	87	76	67	62	52	43.

Sample No.: 24 Lab No.: 96280 Depth: Lift 2
Location: CTTP1

Percent Gravel: 3.0
Percent Sand: 53.9
Percent Silt + Clay: 43.1

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 36.5

Plastic Limit: 24.3

Plasticity Index: 12.2

Classification: SC

Moisture Content = 22.1

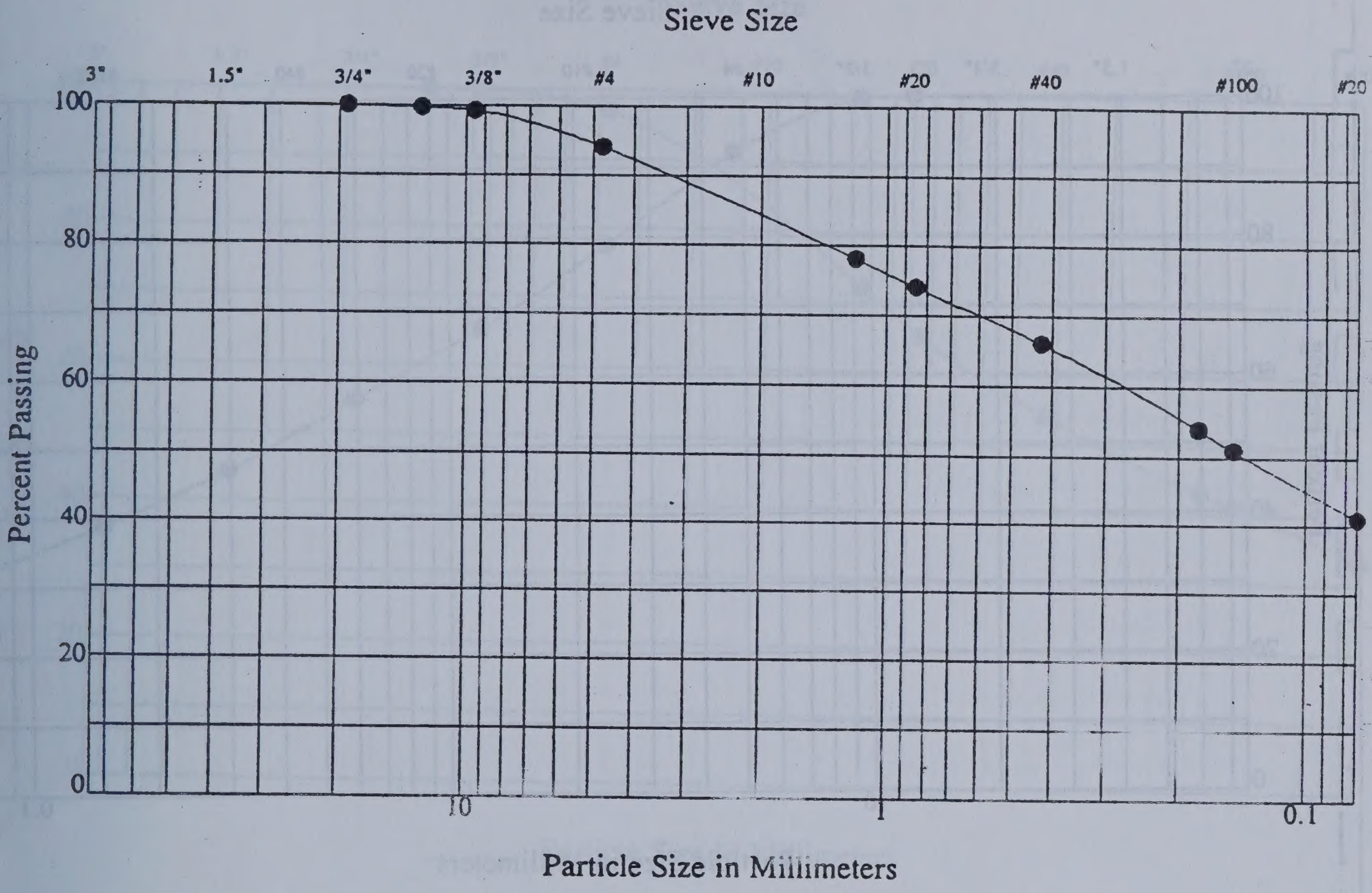
July 12, 19

LAO/Clark - Butte, Montana

Braun Intertec Corporation

Project No.: BJBX-96-057

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	99	94	84	74	66	61	51	40.9

Sample No.: 19 Lab: 96269 Depth: 0' - 6'
Location: CTTP2 - 75% LRO
25% DG
Percent Gravel: 6.0
Percent Sand: 53.1
Percent Silt + Clay: 40.9

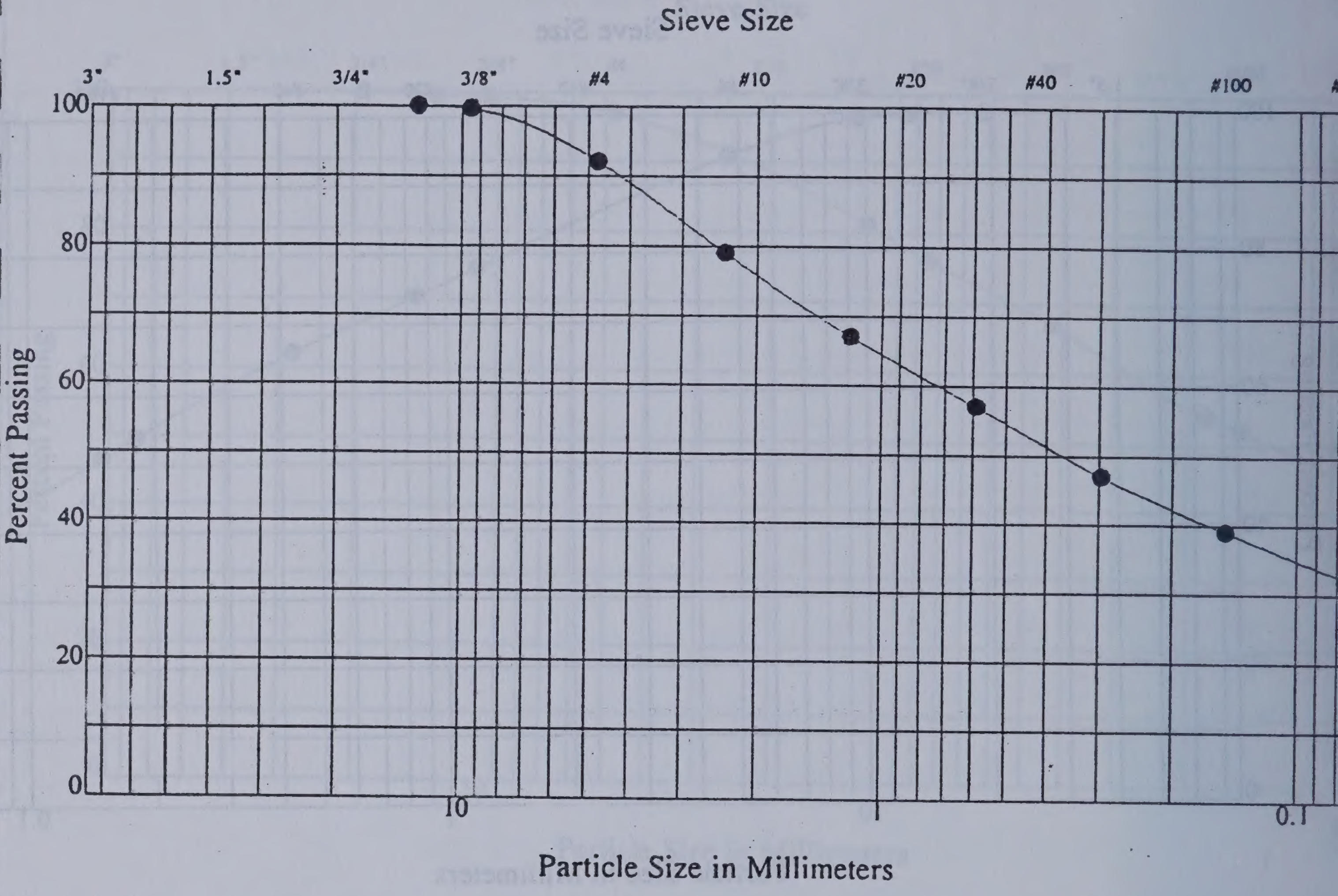
Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit:	33.8
Plastic Limit:	27.6
Plasticity Index:	6.2
Classification:	SM
Moisture Content = NT	

July 9, 1996

LAO/Clark - Butte, Montana

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	100	92	76	62	52	47	39	31.9

Sample No.: 30 Lab No.: 96321 Depth: Lift 1
Location: CTTP2 50% LAO, 50% HOLLOW DG

Percent Gravel: 8.0
Percent Sand: 60.1
Percent Silt + Clay: 31.9

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 31.0
Plastic Limit: 28.0
Plasticity Index: 3.0
Classification: SM
Moisture Content = NA

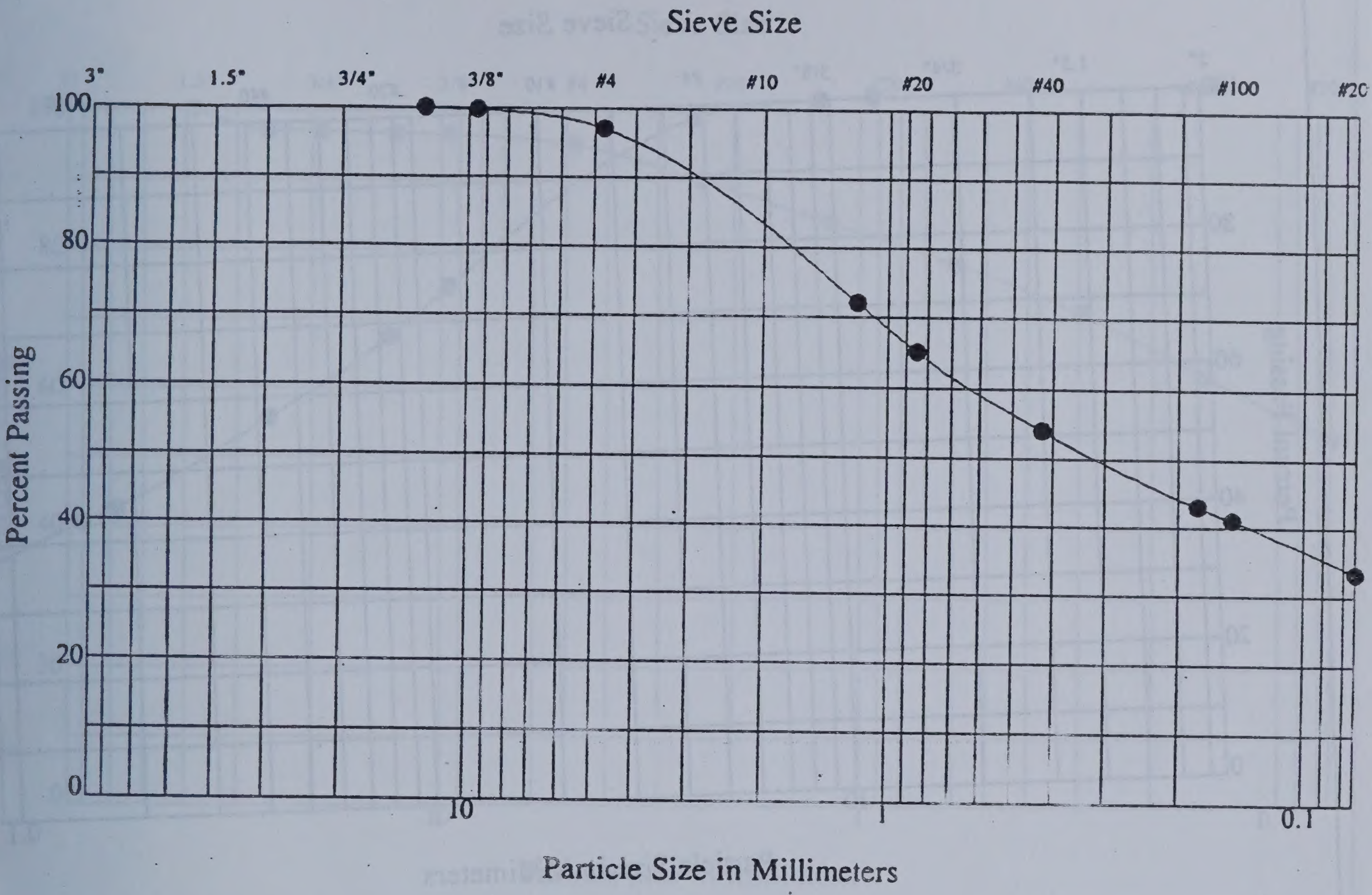
July 26, 199

LAO/Clark - Butte, Montana

Braun Intertec Corporation

Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	100	100	97	81	65	54	49	41	33.3

Sample No.: 26 Lab No.: 96282 Depth: Lift 2
Location: CTTP4

Percent Gravel: 3.0
Percent Sand: 63.7
Percent Silt + Clay: 33.3

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 28.6

Plastic Limit: 21.3

Plasticity Index: 7.2

Classification: SC

Moisture Content = 13.1

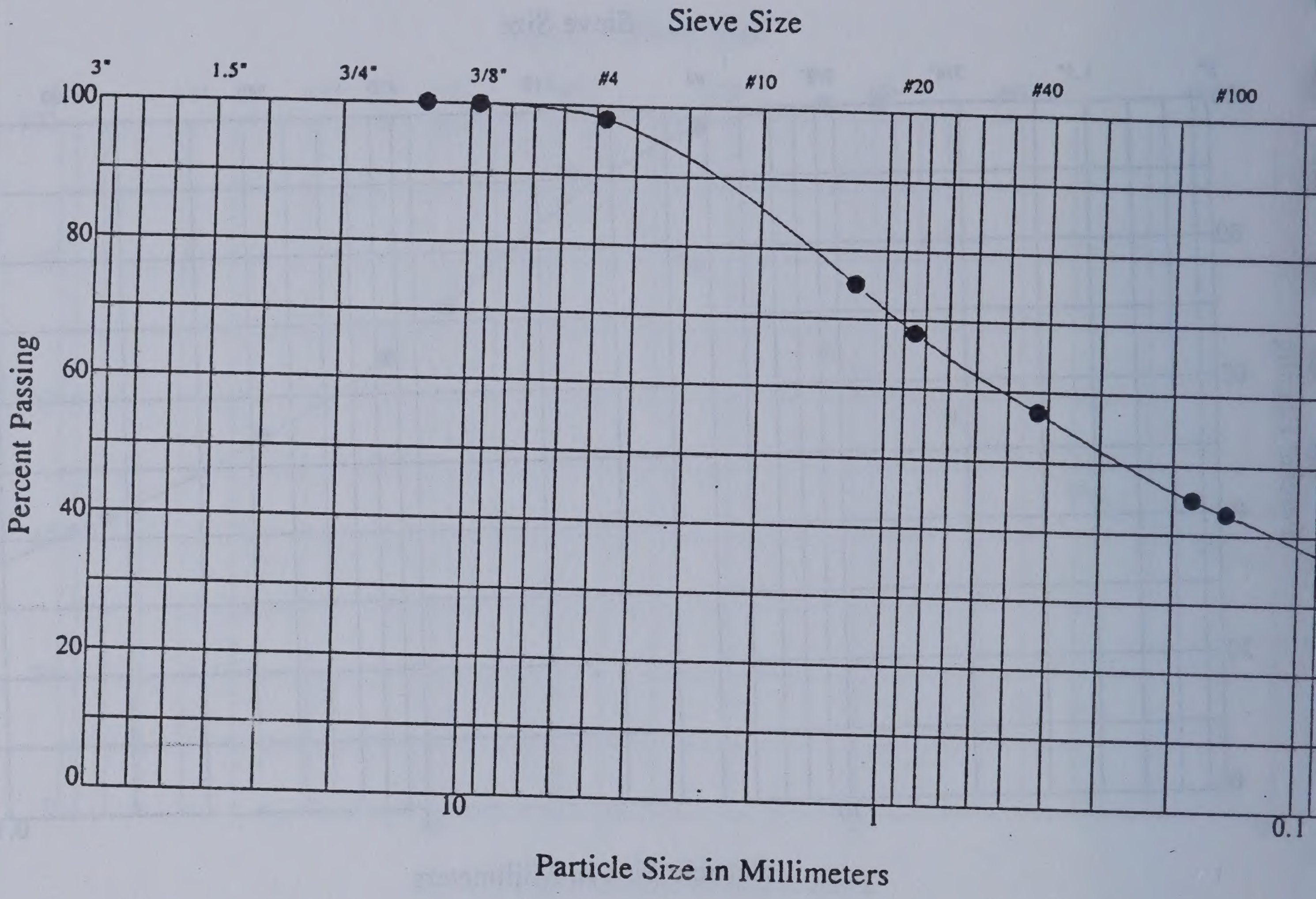
July 12, 1996

LAO/Clark - Butte, Montana

Braun Intertec Corporation

Project No.: BJBX-96-057A

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#20
100	100	100	98	84	68	57	52	43	35.1

Sample No.: 25 Lab No.: 96281 Depth: ~~Lift 2~~ LIFT 3
Location: CTTP4

Percent Gravel:	2.0
Percent Sand:	62.9
Percent Silt + Clay:	35.1

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 28.0

Plastic Limit: 21.1

Plasticity Index: 6.9

Classification: SC-SM

Moisture Content = 13.2

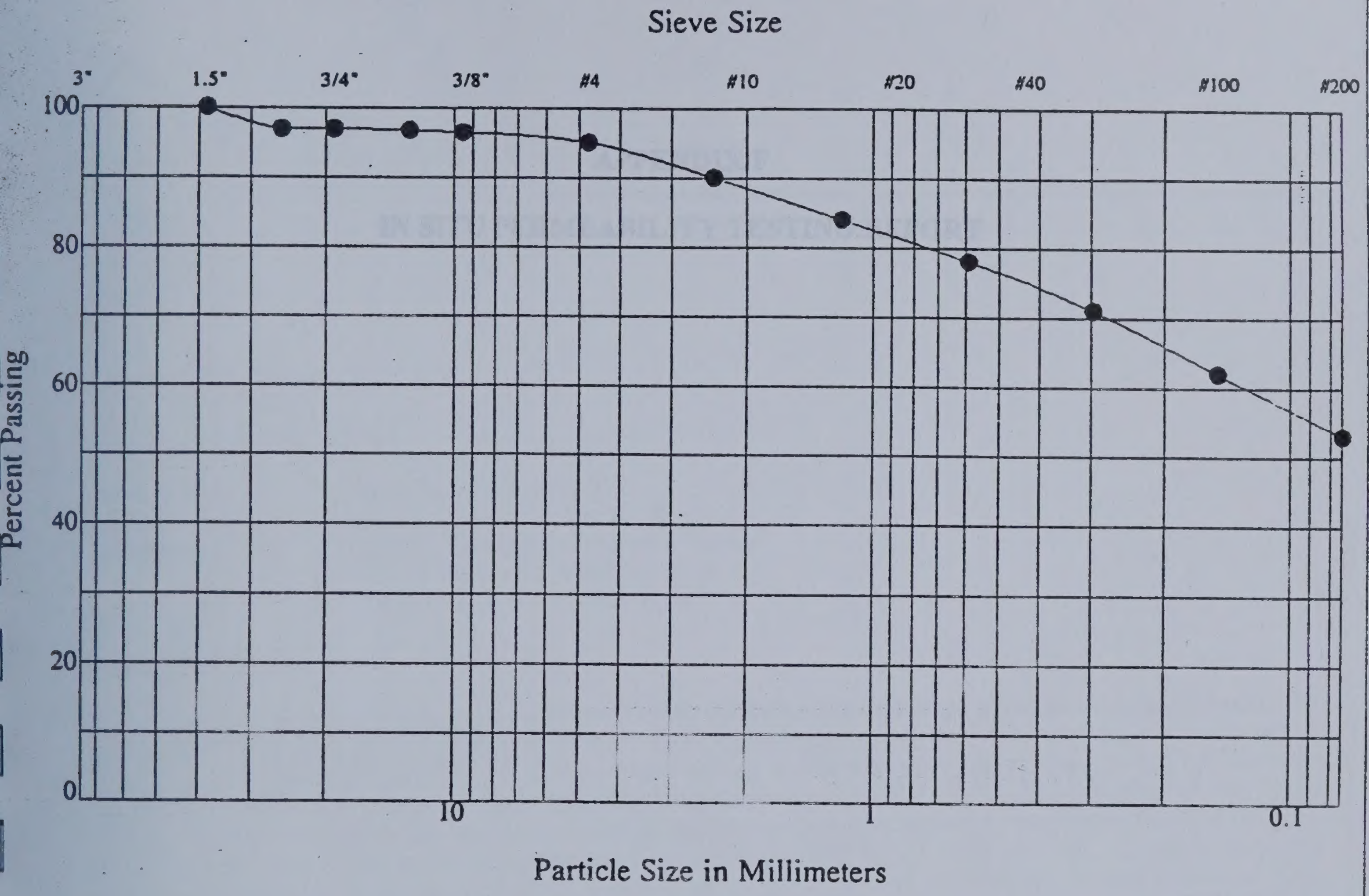
LAO/Clark - Butte, Montana

July 12, 199

Braun Intertec Corporation

Project No.: BJBX-96-057

Sieve Analysis (ASTM C 136, C 117)



Gravel		Sand		
Coarse	Fine	Coarse	Medium	Fine

Percent Passing U.S. Standard Sieve Size

3"	3/4"	3/8"	#4	#10	#20	#40	#50	#100	#200
100	97	96	95	88	81	75	71	62	53.0

Sample No.: 29 Lab No.: 96320 Depth: Lift 2
Location: CTTP5

Percent Gravel: 5.0
Percent Sand: 42.0
Percent Silt + Clay: 53.0

Atterberg Limits (ASTM D 4318)
Moisture Content (ASTM D 2216)

Liquid Limit: 34.0

Plastic Limit: 30.6

Plasticity Index: 3.4

Classification: ML

Moisture Content = NA

July 26, 1996

LAO/Clark - Butte, Montana

raun Intertec Corporation

Project No.: BJBX-96-057A

APPENDIX F

IN SITU PERMEABILITY TESTING REPORT

NTL
ENGINEERING &
GEOSCIENCE, INC.

1505 14th ST. S.W. • P.O. Box 3269 • Great Falls, MT 59403-3269 • (406) 453-5400

July 31, 1996

Pioneer Technical Services
P.O. Box 3445
Butte, Montana 59702

Attention: Mr. Brad Archibald

Subject: Clark Tailings Disposal Area
Field Permeability Testing
South of Butte, Montana

Dear Mr. Archibald:

At your request, we have performed one dimensional field vertical permeability testing of the test pad barrier layers at the referenced project. The testing attempted to include five tests on each of four test pads using different soil materials. Some of the test locations would not permit meaningful testing as evidenced by rapid discharging of the field permeability devices. On Pad No. 1, only three tests were actually performed; and on Pad No. 2, only two tests were actually performed. On Pad No. 4 and Pad No. 5, all five tests were performed. The vertical field permeability testing was conducted in accordance with methods described by Gordon P. Boutwell, Ph.D., P.E., in the technical paper "The STEI Two-Stage Borehole Field Permeability Test" presented at the Containment Liner Technology and Subtitle D Seminar on March 12, 1992, in Houston, Texas.

The test pads were constructed under your supervision prior to our arrival on-site. The devices were installed by hand excavation methods. Total test pad thickness was assumed to be the planned 18 inches. The field permeability test results are summarized on the following page, along with sand cone field density test results for Pad No. 1 and Pad No. 4.

The field permeability tests indicate comfortable compliance with the specification requirement for a coefficient of permeability of $1x10^{-5}$ cm/sec or less. Please call if you have questions.

Sincerely,

Kenneth D. Munski, P.E.
Sr. Materials Engineer

Gary A. Quinn, P.E.
Sr. Geotechnical Engineer

KDM/GAQ/tp

FIELD PERMEABILITY TESTS
CLARK TAILINGS DISPOSAL AREA
SOUTH OF BUTTE, MONTANA

TEST PAD NO. 1

Pad No.-Test No. Identification	Test Location	Casing Embedment (In.)	Total Pad Depth (In.)	Field Vertical Permeability, k_v (cm/sec)*	Field Dry Density (lb/ft^3)**	Field Moisture Content, (%)**
1-1	6' S. & 16' W. NE Pad Corner	10	18	N/A***	98.8	23.9
1-2	4' S. & 11' E. of NW Pad Corner	10	18	$3.9x10^{-7}$	---	---
1-3	7' N. & 6' E. of SW Pad Corner	10	18	$2.7x10^{-7}$	---	---
1-4	5' N. & 24' W. of SE Pad Corner	10	18	$7.2x10^{-7}$	---	---
1-5	14' S. & 3' W. of NE Pad Corner	10	18	N/A***	103.2	20.8

*Stage I testing with temperature/viscosity correction. Average of all tests; see attached statistical summary.

**Sand cone field density result.

***Test could not be performed due to rapid discharge of field permeameter.

FIELD PERMEABILITY TESTS
CLARK TAILINGS DISPOSAL AREA
SOUTH OF BUTTE, MONTANA

TEST PAD NO. 2

Pad No.-Test No. Identification	Test Location	Casing Embedment (In.)	Total Pad Depth (In.)	Field Vertical Permeability, k_v (cm/sec)*
2-1	5' S. & 5' E. of NW Pad Corner	10	18	N/A***
2-2	11' S. & 10' E. of NW Pad Corner	10	18	2.6×10^{-7}
2-3	10' S. & 18' E. of NW Pad Corner	10	18	1.0×10^{-6}****
2-4	6' S. & 22' E. of NW Pad Corner	10	18	N/A***
2-5	10' S. & 28' E. of NW Pad Corner	10	18	N/A***

*Stage I testing with temperature/viscosity correction. Average of all tests; see attached statistical summary.

***Test could not be performed due to rapid discharge of field permeameter.

****Limited test time (3 hr) before rapid discharge terminated the test.

FIELD PERMEABILITY TESTS
CLARK TAILINGS DISPOSAL AREA
SOUTH OF BUTTE, MONTANA

TEST PAD NO. 4

(Note to reviewer: Pad No. 3 was dropped, not tested.)

Pad No.-Test No. Identification	Test Location	Casing Embedment (In.)	Total Pad Depth (In.)	Field Vertical Permeability, k_v (cm/sec)*	Field Dry Density (lb/ft^3)**	Field Moisture Content, (%)**
4-1	7' S. & 14' E. of NW Pad Corner	10	18	$1.6\text{x}10^{-7}$	---	---
4-2	6' S. & 6' E. of NW Pad Corner	10	18	$1.4\text{x}10^{-7}$	128.0	11.0
4-3	4' N. & 19' W. of SE Pad Corner	10	18	$1.6\text{x}10^{-7}$	---	---
4-4	3' S. & 6' W. of NE Pad Corner	10	18	$5.2\text{x}10^{-7}$	---	---
4-5	4' W. & 6' W. of SE Pad Corner	10	18	$4.3\text{x}10^{-7}$	118.3	11.3

*Stage I testing with temperature/viscosity correction. Average of all tests; see attached statistical summary.
**Sand cone field density result.

FIELD PERMEABILITY TESTS
CLARK TAILINGS DISPOSAL AREA
SOUTH OF BUTTE, MONTANA

TEST PAD NO. 5

Pad No.-Test No. Identification	Casing Test Location	Total Embedment (In.)	Field Vertical Pad Depth (In.)	Permeability, k_v (cm/sec)*
5-1	6' S. & 8' E. of NW Pad Corner	10	18	6.8x10^{-7}
5-2	9' S. & 15' E. of NW Pad Corner	10	18	1.3x10^{-7}
5-3	6' S. & 18' E. of NW Pad Corner	10	18	1.5x10^{-7}
5-4	11' S. & 22' E. of NW Pad Corner	10	18	4.2x10^{-7}
5-5	6' S. & 27' E. of NW Pad Corner	10	18	1.4x10^{-7}

*Stage I testing with temperature/viscosity correction. Average of all tests; see attached statistical summary.

FIELD PERMEABILITY STATISTICS

Clark Tailings Disposal Area

Pad 1 Statistics

	Well 2	Well 3	Well 4
Mean	3.92E-07	2.72E-07	7.97E-07
Standard Error	5.52E-08	1.28E-08	1.99E-07
Median	3.12E-07	2.68E-07	4.47E-07
Standard Deviation	2.21E-07	5.13E-08	7.97E-07
Variance	4.88E-14	2.63E-15	6.35E-13
Skewness	2.545943	0.299697	2.620354
Range	8.61E-07	1.81E-07	3.09E-06
Minimum	2.41E-07	1.95E-07	3.61E-07
Maximum	1.1E-06	3.77E-07	3.09E-06
Sum	6.27E-06	4.35E-06	9.57E-06
Count	16	16	12

Pad 2 Statistics

	Well 2	Well 3
Mean	2.56E-07	1E-06
Standard Error	1.66E-08	4.62E-08
Median	2.33E-07	1E-06
Standard Deviation	5.98E-08	1.66E-07
Variance	3.58E-15	2.77E-14
Skewness	-0.57008	2.253732
Range	3.52E-07	1.12E-06
Minimum	1.44E-07	8.84E-07
Maximum	3.52E-07	1.12E-06
Sum	2.56E-06	2E-06
Count	10	2

Pad 4 Statistics

	Well 1	Well 2	Well 3	Well 4	Well 5
Mean	1.61E-07	1.36E-07	1.63E-07	5.24E-07	4.25E-07
Standard Error	1.12E-08	7.23E-09	7.85E-09	3.04E-08	1.42E-08
Median	1.36E-07	1.28E-07	1.51E-07	5.4E-07	4.31E-07
Standard Deviation	4.17E-08	2.7E-08	2.94E-08	9.63E-08	5.31E-08
Variance	1.74E-15	7.31E-16	8.63E-16	9.27E-15	2.82E-15
Skewness	0.683664	1.291359	1.121636	-0.41799	-2.7289
Range	1.09E-07	1.04E-07	1.07E-07	3.11E-07	4.97E-07
Minimum	1.16E-07	1.01E-07	1.24E-07	3.51E-07	3.31E-07
Maximum	2.25E-07	2.05E-07	2.31E-07	6.63E-07	4.97E-07
Sum	2.25E-06	1.91E-06	2.28E-06	5.24E-06	5.53E-06
Count	14	14	14	10	13

Pad 5 Statistics

	Well 1	Well 2	Well 3	Well 4	Well 5
Mean	6.78E-07	1.29E-07	1.52E-07	4.18E-07	1.37E-07
Standard Error	4.03E-08	1.64E-08	6.08E-09	1.78E-08	3.02E-09
Median	6.31E-07	1.19E-07	1.37E-07	3.98E-07	1.4E-07
Standard Deviation	1.45E-07	5.91E-08	2.28E-08	6.43E-08	1.09E-08
Variance	2.12E-14	3.49E-15	5.18E-16	4.14E-15	1.19E-16
Skewness	-1.2467	3.441922	-0.46833	0.222949	0.057463
Range	8.63E-07	2.29E-07	2.01E-07	1.9E-07	3.13E-08
Minimum	4.82E-07	9.45E-08	1.31E-07	3.33E-07	1.21E-07
Maximum	8.63E-07	3.24E-07	2.01E-07	5.23E-07	1.53E-07
Sum	7.45E-06	1.68E-06	1.37E-06	5.43E-06	1.78E-06
Count	11	13	9	13	13

APPENDIX G

LABORATORY PERMEABILITY TESTING DATA

Project: BJBX-95-066A
LAO Segment II
Phase I
Butte, Montana

Date: 14-May-96

Sample: TP-1, Peat/Clay

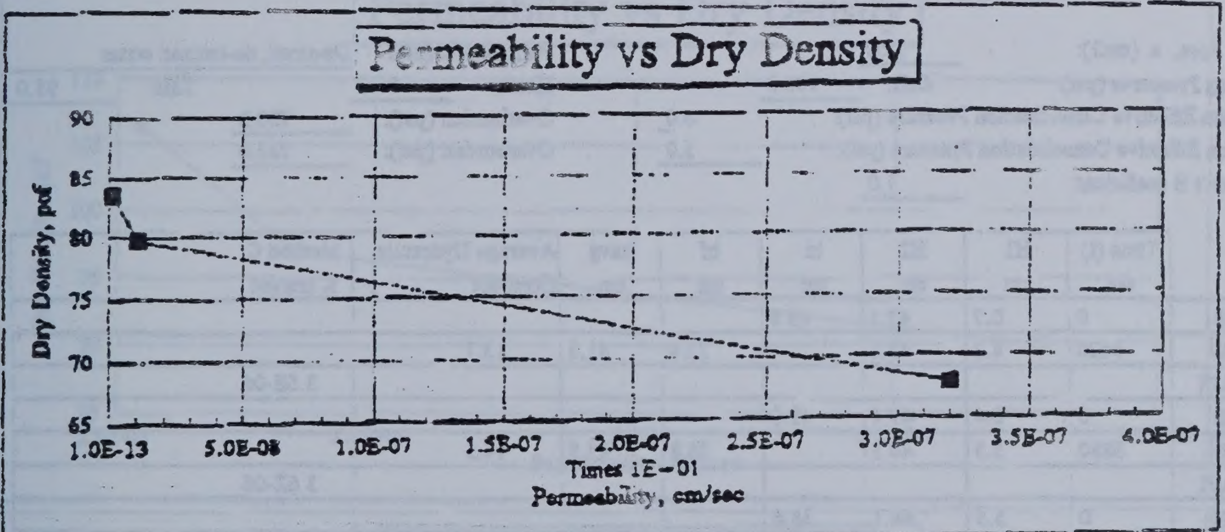
Lab Number 53, 96113

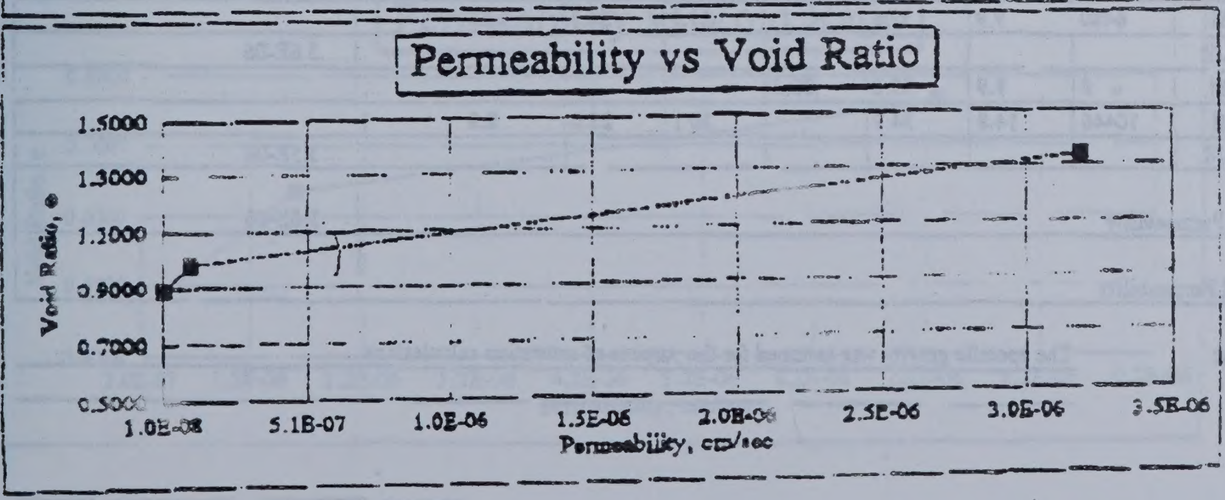
Description: Silty Sand, high plasticity, fine to coarse sand, dark brown to black, moist.

Specific Gravity 2.536

Staged Permeability Test Data

Stage	Overburden (psi)	Permeability (cm/sec)	Dry Density (pcf)	Void Ratio	Relative Compaction (%)
1	2	3.2E-06	67.8	1.3349	91.0%
2	22	1.1E-07	79.7	0.9849	107.0%
3	72	1.3E-08	83.6	0.8921	112.2%


Permeability vs Dry Density


Permeability vs Void Ratio

Permeability Test

ASTM D 5084 (Method C: Falling Head, Rising Tailwater)

Project: BJBX-95-066A
LAO Segment II
Phase I
Butte, Montana

Date: 04/16/96

LAVELLE / HOLLOW PIT

Field No.: 51
Sample: 96104
Depth: --
Location: BSB WWTF Stk Pile

Sample Description: Clayey Sand, fine to coarse grained, low plasticity, light brown, moist
Remolded

Initial		Final	
Wt Specimen + Tare Wet:	669.60	Wt Specimen + Tare Wet:	
Wt. Specimen + Tare Dry:	626.00	Wt. Specimen + Tare Dry:	
Wt. Tare:	120.70	Wt. Tare:	
Moisture Content:	8.6%	Moisture Content:	ERR

Initial Diameter (in):	2.9	Initial Area, A (in2):	6.47	Initial Wt. (gm):	655.10
Initial Ht. (in):	3.0	Initial Dry Unit Wt. (pcf):	117.6	Initial Saturation:	ERR
Final Ht., L (in):	3.0	Final Area, A (in2):	6.47		
Final Diameter (in):	2.9	Final Dry Unit Wt. (pcf):		Final Saturation:	ERR
Sp. Gravity:					

Burette Area, a (cm2): 1.00
Operating Pressures (psi): Cell: 100.0
Permeant Liquid: De-aired, de-ionized water
Head: 95.0 Tail: 95.0
Maximum Effective Consolidation Pressure (psi): 5.0
Overburden (psf): 720.0
Minimum Effective Consolidation Pressure (psi): 5.0
Overburden (psf): 720.0
Skempton's B coeficient: 1.0

	Time (t) sec	H1 cm	H2 cm	hi cm	hf cm	havg cm	Average Hydraulic Gradient	Method C K cm/sec
Initial	0	0.7	49.5	48.8				
Final	9420	8.2	42.0		33.8	41.3	13.7	
Result								3.5E-06
Initial	0	0.4	49.4	49.0				
Final	5880	5.5	44.3		38.8	43.9	14.5	
Result								3 6E-06
Initial	0	5.5	44.1	38.5				
Final	6480	9.9	39.8		29.9	34.3	11.3	
Result								3.6E-06
Initial	0	9.9	39.8	30.0				
Final	10440	14.8	34.9		20.1	25.0	8.3	
Result								3.5E-06
Average Permeability								3 6E-06
Assigned Permeability								

Remarks: The specific gravity was assumed for the purpose of saturation calculations.

Materials Engineer

Project: BJBX-95-066A
LAO Segment II
Phase I
Butte, Montana

Date: 16-Apr-96

Sample: TP-3, Mix Peat Clay

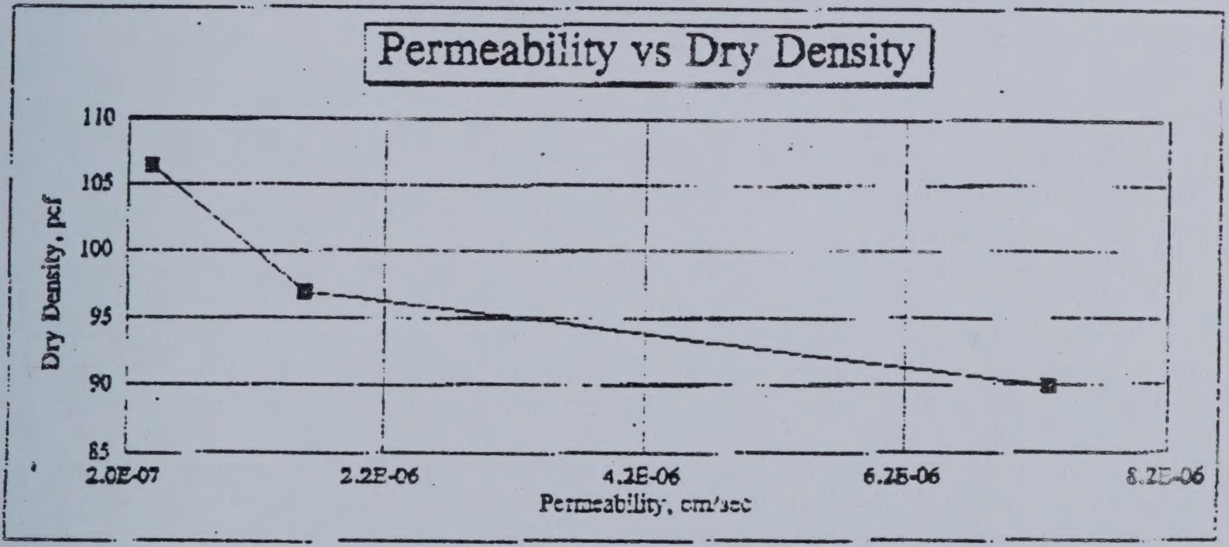
Lab Number 54, 96114

Description: Silty Sand, fine to coarse grained, nonplastic, dark brown, moist.

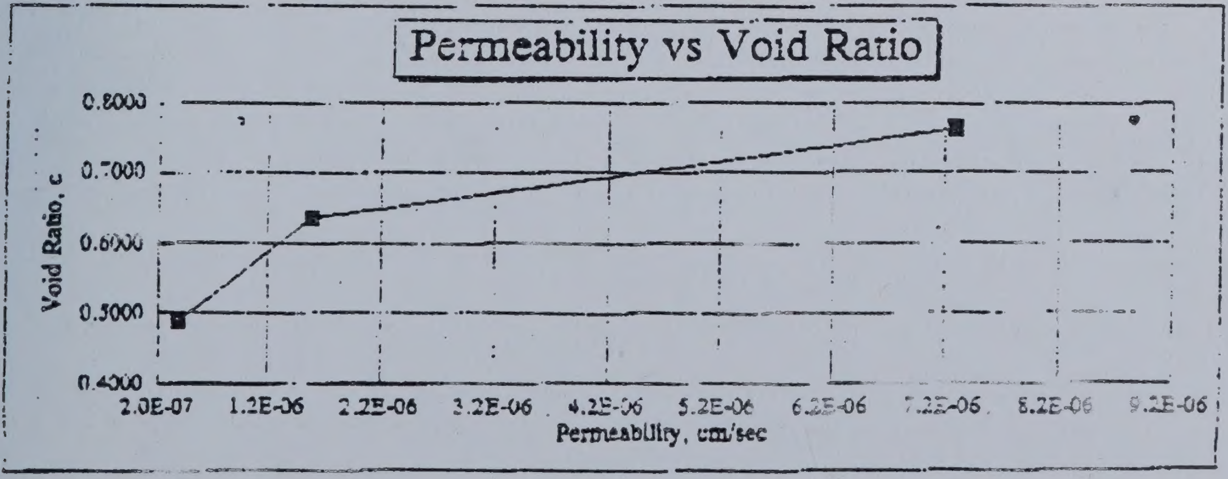
Specific Gravity 2.541

Staged Permeability Test Data

Stage	Overburden (psi)	Permeability (cm/sec)	Dry Density (pcf)	Void Ratio	Relative Compaction (%)
1	2	7.3E-06	89.9	0.7628	89.5%
2	22	1.6E-06	97.0	0.6353	96.5%
3	67	3.9E-07	106.5	0.4891	106.0%



Permeability vs Dry Density



Permeability vs Void Ratio

Silver Bow Co
Closure
Old Butte L.F. #20

RECEIVED

MAY 0 1 1997

MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

CLARK TAILINGS DISPOSAL AREA for PHASE I, SEGMENT II LAO EXPEDITED RESPONSE ACTION TECHNICAL SPECIFICATIONS

Prepared for:

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

April 1997

CLARK TAILINGS DISPOSAL AREA for PHASE I, SEGMENT II LAO EXPEDITED RESPONSE ACTION TECHNICAL SPECIFICATIONS

Prepared for:

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

April 1997

CLARK TAILINGS DISPOSAL AREA for PHASE I, SEGMENT II LAO EXPEDITED RESPONSE ACTION TECHNICAL SPECIFICATIONS

Prepared for:

ARCO
307 East Park Street, Suite 400
Anaconda, Montana 59711

Prepared by:

Pioneer Technical Services, Inc.
P.O. Box 3445
Butte, Montana 59702

April 1997

CLARK TAILINGS DISPOSAL AREA for
PHASE I, SEGMENT II
LAO EXPEDITED RESPONSE ACTION
TECHNICAL SPECIFICATIONS

INDEX TO TECHNICAL SPECIFICATIONS

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01000 GENERAL PROCEDURES 01000-1

DIVISION 2 - SITEWORK

SECTION 02051 MONITORING WELL DISPOSITION 02051-1
SECTION 02110 SITE CLEARING 02110-1
SECTION 02200 EXCAVATION 02200-1
SECTION 02210 FILL MATERIALS AND PLACEMENT REQUIREMENTS 02210-1
SECTION 02270 DRAINAGE DITCHES 02270-1
SECTION 02710 GEOSYNTHETIC MATERIALS 02710-1
SECTION 02720 GEOSYNTHETIC CLAY LINER 02720-1
SECTION 02910 DRYLAND SEEDING AND FERTILIZING 02910-1
SECTION 02920 MULCH 02920-1

SECTION 01000
GENERAL PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

1.02 PROGRESS SCHEDULES

1.03 TEMPORARY FACILITIES AND SITE CONTROL

1.04 SURVEYING

1.05 SUBMITTALS

1.06 TRAFFIC CONTROL AND SITE SAFETY

1.07 EROSION AND SEDIMENT CONTROL

1.08 CONSTRUCTION SEQUENCING AND OTHER CONTRACTORS

1.09 EXISTING STRUCTURES

1.10 RECORD KEEPING REQUIREMENTS

1.11 STANDARD SPECIFICATIONS

1.02 PROGRESS SCHEDULES

Contractor shall prepare an initial project schedule and shall update and maintain the schedule appropriately. Copies of all initial schedules and updates shall be provided to ARCO for review.

1.03 TEMPORARY FACILITIES AND SITE CONTROL

Contractor shall implement an appropriate program to protect the work in progress and ARCO's operations from theft, vandalism, and unauthorized entry.

Contractor shall construct temporary access roads necessary to provide unimpeded traffic

for construction purposes. Contractor shall provide temporary parking areas for project personnel.

Contractor shall use only those haul roads outside of the Clark Tailings work area as specifically approved by ARCO. Contractor shall maintain all haul roads in good condition. Contractor shall provide comprehensive dust control during working and non-working hours to assure that dust levels are minimized and to comply with stated performance standards.

Contractor shall notify and coordinate with all appropriate utility companies and ARCO before conducting work proximate to overhead or buried utilities.

1.04 SURVEYING

Contractor shall provide all surveying needed to complete the work. ARCO will conduct verification surveys and quantity surveys for compensation.

1.05 SUBMITTALS

Contractor shall provide to ARCO complete product information and shop drawings where required for all materials and equipment proposed for incorporation into the project. Information shall include manufacturer, model or catalog designation, reference standards, complete installation instructions, and shop drawings that show dimensions and location of all parts. Information shall be submitted prior to ordering, and in a timely manner to provide ARCO time for review and approval.

In connection with all of the activities described in these Technical Specifications, Contractor shall be responsible and shall notify ARCO and ARCO's representatives of any governmental laws or regulations in addition to those identified in these specifications, including those relating to environmental protection and zoning, that would regulate, prohibit or control the performance by Contractor under these Technical Specifications.

1.06 TRAFFIC CONTROL AND SITE SAFETY

Traffic control and site safety shall be the sole responsibility of Contractor. Adequate signs, barricades, cones, drums, barriers, lighting, flagmen, security guards, and other methods or devices shall be utilized. For public road crossings, Contractor shall provide the following as required by the Butte-Silver Bow Department of Public Works: traffic control; asphalt overlay for truck crossings; cleanup of spilled materials on public right-

of-way; and repaving and patching of damaged public roadways. Contractor shall employ other traffic controls as outlined in the LAO Expedited Response Action Work Plan/Design Report Addendum 1.

1.07 EROSION AND SEDIMENT CONTROL

Contractor shall plan and execute work to control and minimize surface runoff from cuts, fills, and other disturbed areas. Contractor shall employ Best Management Practices (BMPs) to prevent sediment and/or sediment-laden water from entering the flow in Grove Gulch Creek to the extent practicable. BMPs shall stay in place until vegetation is established, as approved by ARCO. Contractor shall prepare and submit to ARCO an Erosion Sediment Control Plan for ARCO's approval prior to beginning site excavation or construction activities. Contractor shall obtain any necessary storm water discharge permits for construction activities from the Montana Department of Environmental Quality, Water Quality Division.

1.08 CONSTRUCTION SEQUENCING AND OTHER CONTRACTORS

Contractor shall coordinate his construction activities with those of any and all other contractors that may be working on the site. Contractor's work shall be conducted in a manner that will not impede the progress of other concurrent construction activities.

1.09 EXISTING UTILITIES

Existing underground utilities in the vicinity of the Work are indicated on the Drawings only to the extent such information has been made available to or discovered by the Engineer in preparing the Drawings. There is no guarantee as to the accuracy and completeness thereof is expressly disclaimed.

The Contractor shall be solely responsible for locating all existing underground installations, including service connections, in advance of excavating or trenching, by contacting the utility owners. The Contractor shall use his own information and shall not rely solely upon information shown on the Drawings concerning existing underground installations.

1.10 EXISTING STRUCTURES

Contractor shall be responsible for protecting existing structures within and external to the construction area. Damage to existing structures shall be corrected by the Contractor at Contractor's expense.

1.11 RECORD KEEPING REQUIREMENTS

Contractor shall maintain on-site, at all times, a complete set of all environmental health and safety documentation, Contract Documents, addenda, change orders, survey records, and other modifications to the Work. Contractor survey data and information shall be submitted to ARCO when requested.

1.12 STANDARD SPECIFICATIONS

These Technical Specifications are supplemented by the *Technical Specifications for Phase I, Segment II Excavation, Lower Area One Expedited Response Action* prepared by ESA Consultants, Inc., the *Montana Public Works Standard Specifications, Fourth Edition*, January 1996 and the *Standard Specifications for Road and Bridge Construction*, 1995 Edition, adopted by the Montana Department of Transportation and the Montana Transportation Commission.

In performance of the Work, these Technical Specifications shall take precedence over the Standard Specifications. If, during the performance of the Work, the Contractor finds a conflict, error or discrepancy between the Technical Specifications and the Standard Specifications, the conflict, error or discrepancy shall be reported to ARCO at once, before proceeding with the affected work. The Contractor may proceed with the work only upon receiving a written interpretation or clarification from ARCO.

END OF SECTION

SECTION 02051
MONITORING WELL DISPOSITION

PART I GENERAL

1.01 SECTION INCLUDES

A. Abandonment of designated monitoring wells.

B. Preservation of designated monitoring wells.

1.02 REGULATORY REQUIREMENTS

A. Confirm with ARCO the identification, location, and proposed disposition of wells prior to beginning construction activities.

B. Disposition of monitoring wells shall be undertaken prior to construction or excavation in areas adjacent to the wells.

C. Wells to be abandoned shall be done so in accordance with the requirements set forth in Title 17, Chapter 50, Section 722 of the Administrative Rules of Montana, et seq.

PART 2 PRODUCTS

2.01 SEALING MATERIALS

Bentonite, grout, or concrete products used for well abandonment shall meet the requirements of ARM 17.50.722 and shall be approved by ARCO.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect existing structures, including monitoring wells to be preserved.

3.02 DISPOSITION

A. Abandonment of Designated Monitoring Wells.

1) Perform abandonment of designated monitoring wells in accordance with applicable regulations.

B. Preservation of Designated Monitoring Wells.

1) Preserve designated monitoring wells in accordance with Drawings.

2) Raise the well casing or remove all contaminated materials from around well casing to grade indicated on Drawings, or as directed by ARCO. Use appropriate methods, including excavation by hand if needed, to remove materials without damage to remaining well casing.

3) Backfill around well casing and/or restore to final grade as directed by ARCO. Provide materials and compaction as specified for backfill adjacent to well area. Backfill around casing with compacted Type C backfill where needed to restore to grade where specific compaction of backfill is otherwise not required.

4) Restore locking steel cap, set in concrete plug, over well casing as directed by ARCO.

END OF SECTION

SECTION 02110
SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of surface debris.

B. Clearing and grubbing of vegetation, including shrubs and grass.

C. Topsoil excavation.

1.02 RELATED SECTIONS

Section 02200 - Excavating.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 PROTECTION

A. Locate, identify, and protect existing utilities from damage.

B. Protect benchmarks and existing structures, including monitoring wells, from damage or displacement.

3.02 CLEARING

A. Clear areas required for access to the site and execution of the Work as shown on the Drawings and as directed by ARCO.

B. Remove identified trees, shrubs, stumps, roots, brush, rubbish, and other objectionable material within the area to be regraded or occupied by permanent construction and from the surfaces of all borrow areas and stockpile sites.

3.03 REMOVAL

A. Remove debris, rock, and extracted vegetation and dispose of materials. All costs in connection with disposing the removed materials will be the responsibility of the Contractor.

3.04 TOPSOIL EXCAVATION/STOCKPILE

A. Topsoil is defined as approximately the upper six inches, or deeper if identified as such by ARCO, of natural soil deposits within presently undisturbed areas or earthen materials placed as part of previous capping efforts. Contractor shall provide ARCO information necessary to determine the areas and depths of topsoil excavation. ARCO will designate areas and depths where topsoil shall be excavated.

B. Excavate topsoil from areas to be further excavated, re-capped or landscaped, or regraded.

C. Stockpile excavated topsoil such that it may be used primarily as Type G fill or Type C fill, as needed, within the work area.

END OF SECTION

SECTION 02200
EXCAVATING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Work under this section includes excavation of materials as required to form the drainage ditches shown on the Drawings; any additional cut needed to accommodate the placement of the LAO materials at the Clark Tailings; excavation of surficial tailings within the Clark Tailings work area; and any other such related excavations as may be deemed necessary by ARCO.

1.02 RELATED SECTIONS

Section 02110 - Site Clearing.
Section 02270 - Drainage Ditches.

1.03 REGULATORY REQUIREMENTS

Sheeting, Shoring, and Bracing: Except where trench banks are cut back on a stable slope, provide and maintain all sheeting, shoring, and bracing necessary to protect workers, and to protect adjoining grades and structures from caving, sliding, erosion or other damage in accordance with Occupational Safety and Health Standards 29 CFR Part 1926 - Construction Standards for Excavations; the Site Specific Health and Safety Plan; and other applicable codes and governing authorities.

1.04 FIELD MEASUREMENTS

Verify that survey benchmarks and intended reference elevations for the Work indicated on the Drawings are accurate as indicated. Notify ARCO of any discrepancies.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Accurately locate, identify, and protect from damage all utilities, benchmarks and monitoring wells not designated for demolition. Contractor must verify that all utilities through the work area have been accurately located prior to commencing any excavation activities.

C. Abandonment of designated monitoring wells shall be undertaken prior to construction or excavation in the areas adjacent to the wells.

D. Protect adjacent structures from damage by excavation work.

3.02 GENERAL EXCAVATION

A. Grade top perimeter of excavation and other work areas to prevent surface runoff from draining into Grove Gulch Creek. Excavated areas shall be graded to promote surface drainage and discourage ponding prior to closure.

B. The use of explosive materials will not be permitted.

C. Excavated materials shall be reused as backfill within the site, or transported to the designated disposal area, as directed by ARCO.

D. Excavation shall conform to the boundaries, elevations and excavation slopes shown on the Drawings.

E. Remove loose material, lumped subsoil, boulders, and loose rock from excavations leaving excavation surface exposed and clean.

F. During all excavation activities, maintain and protect monitoring wells designated to be preserved (see Drawings). If any monitoring wells to be preserved are destroyed during excavation activities, they will be replaced by the Contractor at no additional cost to ARCO.

G. If excavation impacts the landfill cap on the adjacent Old Silver Bow Landfill, the landfill cap shall be repaired at the Contractor's expense.

3.03 SURFICIAL TAILINGS EXCAVATION

A. Surficial Tailings excavation includes the excavation of existing mine wastes from the perimeter of the Clark Tailings Disposal Area and placing the materials within the fill area, as shown on the Drawings.

B. Before excavating surficial tailings, remove and stockpile topsoil in accordance with Section 02110.

C. Excavate surficial tailings as shown on the Drawings or as directed by ARCO or ARCO's representative. Excavate surficial tailings until there is no evidence of remaining mine wastes in the excavation, as determined by ARCO or ARCO's representative. The depth of surficial tailings to be excavated does not exceed 3.0 feet, based on the information available. The extent of surficial tailings shown on the Drawings is an estimate based on the available information from test pits installed at the site; the actual extent of surficial tailings to be removed may be altered by ARCO or ARCO's representative based on field conditions.

D. Place the excavated surficial tailings within the Clark Tailings Disposal area in accordance with the requirements for Type I fill in Section 02210.

E. Grade and/or backfill excavated areas in accordance with Section 02210 to maintain positive drainage from the site.

3.04 TOLERANCES

A. Excavate to within ±0.5 feet of elevation and location and to within ±0.1% of grade as shown on the drawings.

B. Maintain excavation dewatering sufficiently to allow for visual inspection and as-built surveying, to be conducted by ARCO at their discretion.

C. Any areas of over-excavation shall be backfilled at the Contractor's expense to the specifications listed in Section 02210 - Fill Material and Placement Requirements.

3.05 FIELD QUALITY CONTROL

A. Provide for access, visual inspection and surveying of excavation surfaces by ARCO.

B. Contractor shall perform all initial control and grade staking during construction.

Final compliance and survey for payment will be verified by ARCO. Contours and elevations not meeting the requirements of the Construction Drawings and these specifications shall be corrected at the Contractor's expense.

3.06 PROTECTION

A. Protect excavations as required to prevent cave-in or loose soil from falling into excavation.

B. Notify ARCO of conditions encountered which appear unsafe in maintaining excavation as designated on Drawings.

END OF SECTION

SECTION 02210
FILL MATERIALS AND PLACEMENT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

This section specifies fill materials, borrow areas/sources of fill materials, and fill placement requirements for the following:

A. LAO tailings and other soils disposal;

B. LAO debris disposal;

C. Surficial tailings excavated from areas adjacent to the Clark Tailings Disposal Area;

D. Disposal area cap materials;

E. Runoff diversion dikes; and

F. Other miscellaneous backfill.

1.02 RELATED SECTIONS

Section 02270 - Drainage Ditches.
Section 02920 - Mulch

1.03 SUBMITTALS

Submit data sheets and test results from compliance testing of materials provided by Contractor to ARCO for review and approval.

1.04 REFERENCES

A. Sampling and Preparation

1. ASTM D75 - Standard Practice for Sampling Aggregates.

2. ASTM D420 - Recommended Practice for Investigating and Sampling Soil and Rock.

B. Classification

1. ASTM D421 - Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants.

2. ASTM D422 - Standard Method for Particle-Size Analysis of Soils.

3. ASTM D2487 - Classification of Soils for Engineering Purposes.

4. ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).

5. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

C. Density and Moisture Content - Field

1. ASTM D1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.

2. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).

3. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

D. Density and Moisture Content - Laboratory

1. ASTM D698 or AASHTO T99 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.

2. ASTM D1557 or AASHTO T180 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18 inch (457 mm) Drop.

3. ASTM D2216 - Laboratory Determination of Water (Moisture) Content of Soil, Rock and Soil Aggregate Mixtures.

4. ASTM D4253 - Maximum Index Density of Soils Using a Vibratory Table.

5. ASTM D4254 - Minimum Index Density of Soils and Calculation of Relative Density.

6. ASTM D4643 - Determination of Water (Moisture) Content of Soil, Microwave Oven Method.

7. ASTM D4718 - Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.

E. Hydraulic Conductivity - Laboratory

1. ASTM D5084 - Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

F. Hydraulic Conductivity - Field

1. ASTM D5093 - Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed Inner Ring.

PART 2 PRODUCTS

2.01 MATERIALS

A. Type C Fill: Imported clean backfill for over geosynthetic clay liner, excavated areas, and to maintain positive drainage from the site. Also the initial 12" lift of cover soil over Type K and Type L fill. This material shall be free from debris and deleterious or objectionable materials and shall meet the following gradation criteria:

Particle Size	% Finer Than
6-inch average diameter	100
#200 sieve	5-20

B. Type G Growth Media: Imported soil to be placed as growth media in the Clark Tailings Disposal Area and other areas as shown on the Drawings. The material shall be free from debris, rocks, roots, and deleterious or objectionable materials. This material shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/8-inch	85-100
#4	50-90
#40	20-50
#200	10-40

C. Type H Fill: Debris and oversize materials (e.g. greater than 12") removed from LAO to be disposed at the Clark Tailings Disposal Area as shown on the Drawings and described herein.

D. Type I Fill: Mine wastes and associated soils removed from LAO or surficial tailings areas adjacent to the Clark Tailings Disposal Area to be disposed at the Clark Tailings Disposal Area or other areas designated by ARCO. The materials generally consist of well graded sands with silt (SW-SM) to silty sands (SM).

E. Type J Fill: The uppermost (6-inch) lift of mine wastes and associated soils from LAO or other areas designated by ARCO to be disposed at the Clark Tailings disposal area. This material shall be free of debris and deleterious or objectionable materials. The material used for Type J fill shall be meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
#200	10-50

F. Type K Fill: Generally fine-grained materials removed from LAO to be placed as the infiltration barrier layer in the Clark Tailings Disposal Area cap as shown of the Drawings. The materials shall be native sandy organic clays, silts, and silty sands with some organics. The material shall be approved by ARCO for use as Type K fill and shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/8-inch	94
#4	90
#40	50
#200	30-70

Type K fill shall be separated from other materials (such as tailings) to the extent

feasible using standard excavating procedures and equipment during removal from LAO. While no mechanical separation or screening shall be required, Type K materials should be excavated, loaded, and transported to the Clark Tailings Disposal Area separately from Types H, I, and J fill.

G. Type L Fill: Generally fine-grained materials from the Hollow or other borrow pits to be placed as the infiltration barrier layer (as an alternative to Type K fill) in the Clark Tailings Disposal Area cap as shown of the Drawings. The materials shall be native clayey sands (or other fine-grained materials approved by ARCO). The material shall be approved by ARCO for use as Type L fill and shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/8-inch	98
#4	90
#40	45
#200	25-70

G. Type M Fill: Imported granular material to be placed as the capillary break materials in the Clark Tailings Disposal Area cap as shown on the Drawings. This material shall be free from debris and deleterious or objectionable materials and shall meet the following gradation criteria:

Particle Size	% Finer Than
3-inch	100
3/4-inch	10-30
#200	0-10

H. Type N Fill: Mine wastes and native sandy organic clays or silts removed from LAO that are mixed and generally contain excessively high moisture content to be placed within the non-structural or structural fill area at the Clark Tailings Disposal Area, as determined by ARCO or ARCO's representative.

2.02 SOURCE QUALITY CONTROL

A. Tests and analyses of soil materials will be performed in accordance with applicable ASTM test methods, as listed under Part 1.04.

B. If tests indicate materials do not meet specified requirements, change material and

retest at no cost to ARCO.

C. Compliance testing will be performed by ARCO at their discretion.

PART 3 EXECUTION

3.01 SOURCE OF MATERIALS

A. Obtain Type H Fill, Type I Fill, Type J Fill, Type K, and Type N Fill from the LAO excavation.

B. Contractor shall notify ARCO which source of Type C Fill, Type G Growth Media, Type L Fill, and Type M Fill he shall use. Type C and Type G Growth Media may be obtained from borrow areas within 1.5 miles of the Clark Tailings Disposal Area. Type M fill may be hauled from a borrow pit near Crackerville, Montana.

3.02 BORROW SOURCE GRADING/RECLAMATION

Contractor shall grade and prepare final borrow source surfaces for seeding as described in borrow source specific reclamation requirements provided by ARCO.

3.03 PREPARATION FOR PLACEMENT

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of utilities.

C. Locate, identify, and protect utilities that remain from damage, including all monitoring wells not designated for demolition. Notify utility companies for utilities which may be affected by the work, or which cross the work area.

D. Protect bench marks and existing structures from excavating equipment and vehicular traffic.

E. Compact subgrade or existing underlying fill to a minimum depth of 12 inches to meet density requirements for subsequent fill materials as specified in Part 3.05.

F. Cut out soft areas of subgrade or existing underlying fill that cannot be compacted as specified in paragraph E, above. Backfill with material type specified for

subsequent fill, and compact to minimum density requirements for subsequent fill material as specified in Part 3.05.

G. Dewater area as needed prior to fill placement. Fill may not be placed if groundwater is present.

3.04 PLACEMENT

A. Debris (Type H Fill)

1. Incorporate Debris into Tailings and Other Soils Fill Placement: Debris shall be distributed evenly throughout areas of non-structural fill placement, as shown on the Drawings. Large voids within the debris shall be filled with tailings or other soils as directed by ARCO. Debris shall not be concentrated in one or more areas, and shall be spread throughout the fill so that no debris objects are in contact with one another.

2. Designated disposal location: Contractor may dispose of debris in designated disposal locations selected by ARCO. These designated locations would be outside of the non-structural fill area but within the area to be capped, as shown on the Drawings.

B. Tailings and Other Soils (Types I and J Fill)

1. Maintain positive surface drainage to avoid ponding of water on fill.

2. All surfaces upon or against which fill will be placed, including previously placed and compacted layers shall be clean of all objectionable materials, shall be moist but free of standing or ponded water; and shall be scarified as necessary, so as to provide a suitable bond between the existing and newly placed material.

3. Place fill in horizontal lifts with a maximum 12 inch lift thickness before compaction. No fill shall be placed normal to existing or constructed slopes unless approved by ARCO.

4. The uppermost 6 inches (compacted) of tailings material (Type J fill) shall be placed in one lift over the portion of the Clark Tailings Disposal Area impacted by the placement of LAO materials to the line and grade shown on the Drawings or as directed by ARCO.

5. Fill material requiring compaction shall not be frozen when placed.

Material shall not be placed on ice or frozen material.

C. Mixed Mine Waste and Organic Soils (Type N Fill)

1. Maintain positive surface drainage to avoid ponding of water on fill.

2. All surfaces upon or against which fill will be placed, including previously placed and compacted layers shall be clean of all objectionable materials, shall be moist but free of standing or ponded water; and shall be scarified as necessary, so as to provide a suitable bond between the existing and newly placed material.

3. Type N fill shall be placed within debris disposal areas as shown on the Drawings or other locations as designated by ARCO. Type N fill shall not be placed within the structural or non-structural fill Type I fill areas unless the materials are moisture-conditioned, placed, and compacted in accordance with the requirements for Type I fill.

4. Place fill in horizontal lifts with a maximum 18 inch lift thickness before compaction.

5. Type N materials may be used to fill void spaces within debris as required herein.

6. The maximum fill height for Type N materials shall be 10 feet.

D. General Fill to Maintain Drainage

1. General fill to maintain drainage in areas outside of the Clark Tailings Disposal Area (Type C Fill) shall be placed in lifts not to exceed 3 feet in loose thickness. Thinner lifts must be used if necessary to achieve the compaction specification in Part 3.05.

2. Finish grade to within ±0.3 foot of line and 0.1% of grade shown on the Drawings or as directed by ARCO.

3. Maintain positive surface drainage to minimize ponding of water on the fill.

4. Material shall not be frozen when placed. Material shall not be placed on ice or frozen material.

E. Infiltration Barrier Materials

1. All surfaces upon which infiltration barrier materials will be placed shall be free of all objectionable materials, as determined by ARCO, in accordance with Section 02110 - Site Clearing. Surfaces shall be free of standing water and shall be scarified as necessary so as to provide a suitable bond between the underlying materials and the infiltration barrier materials, particularly on side slopes.

2. Place infiltration barrier materials (Type K and Type L fill) in lifts not to exceed 9 inches in loose thickness or 6 inches compacted thickness. Thinner lifts shall be required if necessary to achieve the compaction criteria presented in Part 3.05.

3. Finish grade to within ±0.3 foot of line and 0.1% of grade shown on the Drawings or as directed by ARCO. Upon completion, the total depth of the infiltration barrier layer shall be a minimum of 18 inches compacted thickness.

4. Maintain positive surface drainage to minimize ponding of water on the fill.

5. Material shall not be frozen when placed. Material shall not be placed on ice or frozen material.

F. Capillary Break Materials

1. Place capillary break materials (Type M Fill) in one lift of 3-inches (minimum) loose thickness.

2. Finish grade to within ±0.1 foot of line and 0.1% of grade shown on the Drawings or as directed by ARCO.

3. Type M material shall be transported and placed so as to minimize the migration of fine-sized particles into void spaces. This material shall not be pushed more than 100 feet nor end dumped higher than 10 feet to maintain proper size distribution.

G. Cover Soil and Growth Media

1. Place cover soil (Type C Fill) and growth media (Type G) in lifts not to exceed 12 inches and 6 inches, respectively, in loose thickness.

2. Place Type C and Type G fill in a manner so as to avoid damage to underlying geosynthetic filter fabric.

3. Finish grade to within ±0.3 foot of line and 0.1% of grade shown on the Drawings or as directed by ARCO.

4. Maintain positive surface drainage to minimize ponding of water on the fill.

5. Material shall not be frozen when placed. Material shall not be placed on ice or frozen material.

6 Cover soil and Growth Media shall be mulched in accordance with Section 02920 to provide temporary erosion control after finished-grade has been achieved and approved by ARCO.

3.05 COMPACTION

A. Debris

1. Debris Incorporated in Tailings and Contaminated Soils Fill Placement: Debris shall be crushed and reduced in size to the extent possible prior to covering with fill. Voids within debris disposal areas will be filled with tailings or other soils to minimize void space as directed by ARCO.

2. Designated disposal location: Debris shall be crushed and reduced in size to the extent possible prior to placement in the fill area. Debris in disposal area shall be compacted to the extent possible in lifts not to exceed 18-inches thick (unless otherwise approved by ARCO due to the size of the debris) to minimize future settlement of the fill.

B. Tailings and Contaminated Soils Placed in Structural Fill Areas and the Uppermost Lift (Type J Fill) in Non-Structural Fill Areas

1. Moisture Content: The moisture content, as determined by ASTM D2216, shall be between plus 2 percent and minus 2 percent of the optimum moisture content as determined by ASTM D698. The moisture content shall be uniform throughout the lift.

2. Density

   a. Materials containing less than 5 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted to a minimum of 90 percent of the maximum index density as determined by ASTM D4253.

   b. Materials containing greater than 12 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted to a minimum of 95 percent of the maximum index density as determined by ASTM D698.

   c. Materials containing 5 to 12 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted in accordance with either specification a. or b. above at the discretion of ARCO.

C. Tailings and Contaminated Soils Placed in Non-Structural Fill Areas

1. Moisture Content: The moisture content, as determined by ASTM D2216, shall be between plus 2 percent and minus 2 percent of the optimum moisture content as determined by ASTM D698, unless otherwise approved by ARCO on a material-specific basis. The moisture content shall be uniform throughout the lift.

2. Density

   a. Materials containing less than 5 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted to a minimum of 85 percent of the maximum index density as determined by ASTM D4253.

   b. Materials containing greater than 12 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted to a minimum of 90 percent of the maximum index density as determined by ASTM D698.

   c. Materials containing 5 to 12 percent by dry weight of particles passing a U.S. #200 standard screen shall be compacted in accordance with either specification a. or b. above at the discretion of ARCO.

D. Mixed Mine Waste and Organic Soils (Type N Fill)

1. Moisture Content: Type N materials shall be dried as required so that no free water is drawn from the materials during placement and compaction.

2. Density: Type N materials shall be compacted by tracking over each lift a minimum of two times with a Caterpillar D8 bulldozer or sufficiently to support traffic by construction equipment, whichever is greater.

E. General Fill to Maintain Drainage

Density: Type C materials shall be compacted sufficiently to support traffic by construction equipment.

F. Infiltration Barrier Materials (Type K and L Fill)

1. Moisture Content: The moisture content, as determined by ASTM D2216, shall be between 0 to +4% of the optimum moisture content as determined by ASTM D698. The moisture content shall be uniform throughout the lift. Placed materials not meeting this requirement, as determined by testing by ARCO, shall be scarified to the depth of the lift in question, wetted or dried as necessary to meet this requirement, and mixed to a uniform water content.

2. Density: Materials shall be compacted to the density required to attain a minimum hydraulic conductivity of 1 x 10^{-5} cm/sec. Based on laboratory testing conducted to date, it is anticipated that the materials must be compacted to 95% of the maximum dry density as determined by ASTM D698. The compaction required to meet the hydraulic conductivity specification will be verified by ARCO through in situ hydraulic conductivity testing prior to construction. Based on the results of the in situ testing, the actual compaction specification for these materials may be less than or greater than 95% of the maximum dry density as determined by ASTM D698.

G. Capillary Break Materials (Type M Fill)

Density: Capillary break materials shall be compacted sufficiently to support traffic by construction equipment.

H. Cover Soil and Growth Media

Cover soil and growth media shall be placed as loose as possible to promote vegetative growth.

3.06 SITE GRADING

Grade all areas including excavated, filled, and transition areas to obtain the finished surface shown on Drawings, to the tolerances specified in Part 3.04 above. Finished surface shall be reasonably smooth, compacted, and free from irregular surface changes. Finished surfaces shall have positive drainage to minimize ponding of water. After the finished surface has been approved by ARCO, mulch shall be applied (with the exception of those areas to be covered with erosion control mat) in accordance with Section 02920 to provide temporary erosion control.

3.07 FIELD QUALITY CONTROL

A. Testing for compaction control and gradation will be conducted by ARCO. Embankment not meeting the requirements of these specifications shall be corrected at no additional expense to ARCO.

B. Contractor shall perform all initial control and grade staking during construction. Final compliance and survey for payment will be verified by ARCO. Contours and elevations not meeting the requirements of these specifications shall be corrected at the Contractor's expense.

END OF SECTION

SECTION 02270
DRAINAGE DITCHES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Work under this section includes construction of the drainage ditches shown on the Drawings.

1.02 RELATED SECTIONS

Section 02110 - Site Clearing.
Section 02200 - Excavation.
Section 02210 - Fill Materials and Placement Requirements.
Section 02710 - Geosynthetic Materials.
Section 02720 - Geosynthetic Clay Liner
Section 02910 - Dryland Seeding and Fertilizing.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, cross sections, and datum.

B. Accurately locate, identify, and protect from damage all utilities, benchmarks and monitoring wells not designated for demolition. Contractor must verify that all utilities through the work area have been accurately located prior to commencing any excavation activities.

3.02 EXCAVATION

A. All excavation shall be conducted in accordance with Section 02200 - Excavation.

B. Grade channels to subgrade to the lines, grades and cross sections shown on the Drawings.

C. Excavated materials shall be reused as backfill within the site, or transported to the designated disposal area, as directed by ARCO.

D. Remove loose material, lumped subsoil, boulders, and loose rock from excavations leaving excavation surface exposed and clean.

E. Place cover materials as specified on the Drawings and in accordance with Section 02210 - Fill Materials and Placement Requirements and Section 02720 - Geosynthetic Clay Liner.

F. Upon approval of finish grade by ARCO, all ditches shall be seeded and fertilized as specified in Section 02910 - Dryland Seeding and Fertilizing.

G. Following application of seed and fertilizer, erosion control mat shall be installed in accordance with Section 02710 - Geosynthetic Materials.

3.03 TOLERANCES

A. Invert elevation of drainage ditches shall be constructed to within ±0.3 feet of elevation and location and to within ±0.1% of grade as shown on the Drawings.

C. Any areas of over-excavation shall be backfilled at the Contractor's expense to the specifications listed in Section 02210 - Fill Material and Placement Requirements.

3.04 FIELD QUALITY CONTROL

A. Provide for access, visual inspection and surveying of excavation surfaces by ARCO.

B. Contractor shall perform all initial control and grade staking during construction. Final compliance survey for Payment will be verified by ARCO prior to seeding, fertilizing and erosion control mat installation. Contours and elevations not meeting the requirements of the Plans and these specifications shall be corrected at the Contractor's expense.

END OF SECTION

SECTION 02710
GEOSYNTHETIC MATERIALS

PART I GENERAL

1.01 SECTION INCLUDES

This section includes product specifications for geotextile materials, storage and handling guidelines, and installation procedures for the following:

A. Erosion control mat.
B. Geosynthetic Filter Fabric.

1.02 RELATED SECTIONS

Section 02200 - Excavation.
Section 02270 - Drainage Ditches.
Section 02910 - Dryland Seeding and Fertilizing.

1.03 SUBMITTALS

Submit the following to ARCO:

A. Product Data: Submit catalog data and installation instructions for materials specified herein and proposed for use.

B. Certificates of Compliance: Furnish certification that standards specified herein are met.

PART 2 PRODUCTS

2.01 EROSION CONTROL MAT

Erosion control mat used for channel lining shall be a machine-produced mat of 100% coconut fiber. The mat shall be of consistent thickness with the coconut fiber evenly distributed over the entire area of the mat. The blanket shall be covered on the top and bottom with black polypropylene netting having ultraviolet additives to reduce breakdown and an opening size adequate to maintain uniformity in the mat. The mat shall be sewn together with polyester threads spaced at 1.5" centers or less.

Erosion control mat shall be model C125 as manufactured by North American Green, 14649 Highway 41, North Evansville, IN 47711, (800) 772-2040 and distributed by Roscoe Steel & Culvert Company, 5405 Momont Road, Missoula, MT 59802, (406) 542-0345, or equivalent, as approved by ARCO.

2.02 GEOSYNTHETIC FILTER FABRIC

Geosynthetic filter fabric shall be placed directly over the capillary break materials (Type M fill) as shown on the Drawings. Geosynthetic filter fabric shall be a nonwoven material composed of synthetic fibers. Fibers used in the manufacture of the geotextile shall be composed of at least 85 percent by weight polyolefins, polyesters, or polyamides. The geotextile shall be free of defects or flaws which affect its physical properties.

The geotextile filter fabric shall meet the minimum average roll values identified below:

PROPERTY	TEST METHOD	MINIMUM VALUE	UNITS
Grab Strength	ASTM D4632	85	lbs
Mullen Burst Strength	ASTM D3786	185	lb/in^2
Puncture	ASTM D4833	55	lbs
Trapezoid Tear	ASTM D4533	35	lbs
Flow Rate	ASTM D4491	140	gal/min/ft^2
Apparent Opening Size	ASTM D4751	70	US Sieve Number

2.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaging: Each roll of geosynthetic material shall be packaged individually with suitable wrapping to protect the material during normal storage and handling, from damage due to ultraviolet light, and moisture.

B. Labeling: Each roll shall be identified by a tag or label securely affixed to the outside of the roll on one end. The label shall include the manufacturer or supplier, the style number and the roll number.

C. Storage: Store all geosynthetic materials elevated off the ground and ensure that they are adequately covered. Keep fabrics in the manufacturer's wrapping until just before use.

D. Geosynthetics damaged during transport, storage or placement shall be replaced at no expense to ARCO.

PART 3 EXECUTION

3.01 EROSION CONTROL MAT

A. SITE PREPARATION: The channel to be covered by the erosion control mat shall be graded to a smooth condition free from protruding objects such as rocks, sticks and other debris. Wheel ruts, footprints, or undulations allowing separation of erosion control mat from the surface by more than 2 inches must be graded smooth before installation. Prior to placing the mat, the channel shall be seeded and fertilized in accordance with Section 02910.

B. INSTALLATION: The erosion control mat shall be installed in strict accordance with the manufacturers recommendations for channel installations and according to the following:

1. Blankets shall be placed end over end (shingle style) with a 6 inch overlap. Blankets shall be placed so as to conform to the underlying terrain prior to stapling. Blankets shall not be stretched. A double row of staggered staples 4 inches apart shall be used to secure the rolls.

2. Installation shall occur starting at the top of the channel by anchoring the blanket in a 6 inch deep by 6 inch wide trench. Trench shall be backfilled after stapling.

3. Blankets on side slopes shall overlap center blanket a minimum of 4 inches and shall be anchored at the top of slope in a 6 inch by 6 inch anchor trench.

4. The terminal end of the blankets must be anchored in a 6 inch by 6 inch trench. The trench shall be backfilled and compacted after stapling.

C. REPAIRS AND SPECIAL INSTALLATION:

1. The erosion control mat shall be installed so as not to significantly disturb the seedbed. If the seedbed is seriously disturbed, ARCO may require re-preparing and reseeding at no additional cost to ARCO.

2. Should the erosion control mat be torn or otherwise damaged, the

damaged area shall be repaired or replaced to manufacturer's specifications by the contractor at no cost to ARCO.

3.02 GEOSYNTHETIC FILTER FABRIC

Install the geosynthetic filter fabric in accordance with the manufacturer's recommendations and the requirements listed below.

A. SUBGRADE PREPARATION: Shape the geosynthetic filter fabric subgrade (Type M fill) to the lines and grades shown on the Drawings. Shape slopes to gradually transition into slope adjustments without noticeable breaks. Remove any sharp protrusions or other objectionable material which may damage the geosynthetic filter fabric.

B. PLACEMENT: The filter fabric shall be unrolled as smoothly as possible on the prepared subgrade. The material shall be free of tension, stress, or wrinkles. Overlap the sheets a minimum of four inches and a maximum of six inches. Filter fabric seams shall be parallel with slopes greater than 10 percent.

C. SEAMING: Filter fabric panels shall be continuously seamed via heat bonding. Alternatively, the panels may be seamed via continuous sewing using polymeric thread with chemical and ultraviolet light resistance properties equal to or exceeding those of the filter fabric material.

E. DEFECTS AND REPAIRS: Damaged geotextiles shall be repaired immediately. Repair damaged areas by installing a patch of the geotextile filter fabric that extends at least three feet beyond the damaged or flawed area in all directions. Continuously seam the patch to the underlying geotextile via heat bonding. Damaged geotextiles shall be repaired at no cost to ARCO.

E. PLACING COVER SOILS: Type C fill to be placed over the geotextile filter fabric shall be placed by pushing the materials from the edge of the geotextile or from previously placed cover materials. Construction traffic shall not be allowed directly on the geotextile filter fabric. A minimum six-inch lift of Type C material shall be maintained between the equipment tracks or wheels and the geotextile filter fabric. Sudden stops or turns of equipment operating on cover soil placed over the geotextile filter fabric shall be avoided.

END OF SECTION

SECTION 02720
GEOSYNTHETIC CLAY LINER

PART I GENERAL

1.01 SECTION INCLUDES

This section includes product specifications for geomembrane materials, storage and handling guidelines, and installation procedures for the following:

A. Geosynthetic Clay Liner (GCL).

1.02 RELATED SECTIONS

Section 02110 - Site Clearing.
Section 02200 - Excavation.
Section 02210 - Fill Materials and Placement Requirements

1.03 SUBMITTALS

Submit the following to ARCO:

A. Conceptual description of the proposed plan for placement of the GCL panels over the prepared area of installation.

B. GCL manufacturer's MQC Plan for documenting compliance to Sections 2.02 and 2.03 of these specifications.

C. At the Engineer's or Owner's request:

  1. A representative sample of the GCLs.
  2. A project reference list for the GCL(s) consisting of the principal details of at least ten projects totaling at least 10 million square feet in size.

D. Upon shipment, the Contractor shall furnish the GCL manufacturer's Quality Assurance/Quality Control (QA/QC) certifications to verify that the materials supplied for the project are in accordance with the requirements of this specification.

E. As installation proceeds, the Contractor shall submit certificates of subgrade acceptance, signed by the Contractor and CQA Inspector (See Section 1.04) for

each area that is covered by the GCL.

1.04 CONSTRUCTION QUALITY ASSURANCE (CQA)

A. ARCO will provide an independent inspector for CQA of the GCL installation. The CQA Inspector will be responsible for monitoring and documenting activities related to the CQA of the GCL, throughout installation.

B. Testing of the GCL, as necessary to support the CQA effort, shall be performed by a laboratory independent from the GCL manufacturer and installer.

PART 2 PRODUCTS

2.01 GEOSYNTHETIC CLAY LINER

A. The GCLs shall consist of a layer of natural sodium bentonite clay encapsulated between two geotextiles and shall comply with all of the criteria listed in this Section. Prior to using an alternate GCL, the Contractor must furnish independent test results demonstrating that the proposed alternate material meets all requirements of this specification. The Contractor also must obtain prior approval of the alternate GCL by the Project Engineer.

B. Reinforced GCL must be used on slopes as designated by the Engineer. Unreinforced GCL may be used on flat areas of the site not exceeding 10H:1V in steepness.

2.02 MATERIALS

A. The GCL shall be Bentomat® ST as manufactured by CETCO, 1350 West Shure Drive, Arlington Heights, Illinois 60004 USA (708-392-5800), or an ARCO-approved equivalent.

B. The GCL(s) and their components shall have the following properties:

MATERIAL PROPERTY	TEST METHOD	REQUIRED VALUES[1]
Bentonite Free Swell	USP / NF XVII	24 mL/2g min.
Bentonite Fluid Loss	API 13A/13B	18 mL max.
Bentonite Mass/Area	ASTM D 5261	0.95 lbs/ft^2 (4.6 kg/m^2)
GCL Grab Strength[2]	ASTM D 4632	90 lbs (400 N)
GCL Grab Elongation	ASTM D 4632	15 percent typical
GCL Peel Strength	ASTM D 4632	15 lbs (65 N)
GCL Permeability[3]	ASTM B 5084	5 x 10^{-9} cm/sec
GCL Hydrated Internal Shear Strength[4]	ASTM D 5321	500 psf (24 kPa) typical

Notes:

[1] All Values minimum average roll values unless otherwise indicated.

[2] Tensile testing performed in the machine direction.

[3] Permeability with deaired distilled water at 5 psi (35 kPa) confining pressure and 2 psi (15 kPa) head pressure.

[4] Peak value measured at 200 psf (30 kPa) normal stress. Site-specific materials, GCL products, and test conditions must be used to verify internal and interfacial stability of the proposed design.

C. The minimum acceptable dimensions of full-size GCL panels shall be 13.8 feet (4.2 m) in width and 125 feet (38 m) in length. Short rolls [those manufactured to a length greater than 70 feet (21 m) but less than a full-length roll] may be supplied at a rate no greater than 3 per truckload or 3 rolls every 36,000 square feet (500 m^2) of GCL, whichever is less.

D. A 6-inch (150 mm) overlap guideline shall be imprinted on both edges of the upper geotextile component of the GCL as a means for providing quality assurance of the overlap dimension. Lines shall be printed in easily visible, non-toxic ink.

2.03 PRODUCT QUALITY DOCUMENTATION

The GCL manufacturer shall provide ARCO or ARCO's representatives with manufacturing QA/QC certifications for each shipment of GCL. The certifications shall be signed by a responsible party employed by the GCL manufacturer and shall include:

A. Certificates of analysis for the bentonite clay used in GCL production demonstrating compliance with the parameters in Section 2.02.

B. Test data for geotextile materials used in GCL production, including, at a minimum, mass/area and tensile test data demonstrating compliance with the GCL manufacturer's MQC plan.

C. GCL lot and roll numbers supplied for the project (with corresponding shipping information).

D. Manufacturer's test data for the finished GCL product, including the parameters of bentonite mass/area, tensile strength, and representative permeability data demonstrating compliance with the performance parameters shown in Table 1.

2.04 PRODUCT LABELING

A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Product identification information (Manufacturer's name and address, brand name, product code).
2. Lot number and roll number.
3. Roll length, width and weight.

2.05 PACKAGING

A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet (UV) light.

2.06 ACCESSORY BENTONITE

A. The granular bentonite or bentonite sealing compound used for seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer.

PART 3 EXECUTION

3.01 SHIPPING AND HANDLING

A. The manufacturer assumes responsibility for initial loading of the GCL. Shipping will be the responsibility of the party paying the freight. Unloading, on-site handling and storage of the GCL are the responsibility of the Contractor, Installer or other designated party.

B. A visual inspection of each roll should be made by the Contractor during unloading to identify if any packaging has been damaged. Rolls with damaged packaging should be marked and set aside for further inspection. The packaging should be repaired prior to being placed in storage.

C. The Contractor should contact the GCL Manufacturer prior to shipment to ascertain the appropriateness of the proposed unloading methods and equipment.

3.02 Storage

A. Storage of the GCL rolls shall be the responsibility of the Contractor. A dedicated storage area shall be selected at the job site that is away from high traffic areas and is level, dry and well- drained.

B. Rolls should be stored in a manner that prevents sliding or rolling from the stacks and may be accomplished by the use of chock blocks or by use of the dunnage shipped between rolls. Rolls should be stacked at a height no higher than that at which the lifting apparatus can be safely handled (typically no higher than four).

C. All stored GCL materials and the accessory bentonite must be covered with a plastic sheet or tarpaulin until their installation.

D. The integrity and legibility of the labels shall be preserved during storage.

E. Any GCL that is visibly damaged or wetted during storage shall not be used and shall be replaced at the Contractor's expense.

3.03 Earthwork

A. Any earthen surface upon which the GCL is installed shall be prepared and compacted in accordance with the project specifications and drawings. The surface shall be smooth, firm, and unyielding, and free of:

1. Vegetation.
2. Construction Debris.
3. Sticks.
4. Sharp rocks.
5. Void spaces.
6. Ice.
7. Abrupt elevation changes
8. Standing water
9. Cracks larger than one-quarter inch (6 mm) in width
10. Any other foreign matter that could contact the GCL.

B. Subgrade surfaces consisting of granular soils or gravel are not acceptable. Subgrade soils should possess particles with extruding greater than 3/4-inch.

C. Immediately prior to GCL deployment, the subgrade shall be final-graded to fill in all voids or cracks and then smooth-rolled to provide the best practicable surface for the GCL. At completion of this activity, no wheel ruts, footprints or other irregularity shall exist in the subgrade. Furthermore, all protrusions extending more than one-half inch (12mm) from the surface shall either be removed, crushed or pushed into the surface with a smooth-drum compactor.

D. On a continuing basis, ARCO or ARCO's representative shall certify acceptance of the subgrade before GCL placement.

E. It shall be the installer's responsibility thereafter to indicate to the Engineer any change in the condition of the subgrade that could cause the subgrade to be out of compliance with any of the requirements listed in this Section.

F. At the top of sloped areas of the job site, an anchor trench for the GCL shall be excavated in accordance with the project plans. The trench shall be excavated and approved by the CQA Inspector prior to GCL placement. No loose soil shall be allowed at the bottom the trench and no sharp corners or protrusions shall exist anywhere within the trench.

3.04 GCL Placement

A. GCL rolls should be delivered to the working are of the site in their original packaging. Immediately prior to deployment, the packaging should be carefully removed without damaging the GCL. The orientation of the GCL (i.e., which side faces up) should be in accordance with the Engineer's or Manufacturer's recommendations. Unless otherwise specified, however, the GCL shall be installed such that the product name printed on one side of the GCL faces up.

B. Equipment which could damage the GCL shall not be allowed to travel directly on it. If the installation equipment causes rutting of the subgrade, the subgrade must be restored to its originally accepted condition before placement continues.

C. Care must be taken to minimize the extent which the GCL is dragged across the subgrade in order to avoid damage to the bottom surface of the GCL. A temporary geosynthetic subgrade covering commonly known as a slip sheet or rub sheet may be used to reduce friction damage during placement.

D. The GCL shall be placed so that seams are parallel to the direction of the slope. Seams should be located at least 3 feet (1 m) from the toe and crest of slopes steeper than 4H:1V.

E. All GCL panels should lie flat underlying surface, with no wrinkles or fold, especially at the exposed edges of the panels.

F. Only as much GCL shall be deployed as can be covered at the end of the working day with soil, a geomembrane, or a temporary waterproof tarpaulin. The GCL shall not be left uncovered overnight. If the GCL is hydrated when no confining stress is present, it may be necessary to remove and replace the hydrated material. The project Engineer, CQA inspector, and GCL supplier should be consulted for specific guidance if premature hydration occurs.

G. As directed by the project drawings, the end of the GCL roll shall be placed in an anchor trench at the top of the slope. The front edge of the trench should be rounded so as to eliminate any sharp corners. Loose soil should be removed from the floor of the trench. The GCL should cover the entire trench floor but the rear trench wall.

3.05 Seaming

A. The GCL seams are constructed by overlapping their adjacent edges. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris. Supplemental bentonite is required if the GCL has one or more non-woven needlepunched geotextiles.

B. The minimum dimension of the longitudinal overlap shall be 6 inches (150 mm). End-of-roll seams shall be overlapped a minimum of 12 inches (300 mm).

C. Seams at the ends of the panel should be constructed such that they are shingled in the direction of the grade to prevent the potential for runoff flow to enter the overlap zone.

D. Bentonite-enhanced seams are constructed by overlapping adjacent panels as instructed above, exposing the underlying edge, and then applying a continuous bead of granular sodium bentonite along a zone defined by the edge of the underlying panel and the 6-inch (150 mm) line. The bentonite shall be applied at a minimum application rate of one quarter pound per lineal foot (0.4 kg/m).

3.06 Detail Work

A. The GCL shall be sealed with bentonite around penetrations and embedded structures embedded in accordance with the design drawings and the GCL Manufacturer.

B. Cutting the GCL should be preformed using a sharp utility knife. Frequent blade changes are recommended to avoid damage to the geotextile components of the GCL during the cutting process.

3.07 Damage Repair

If the GCL is damaged (torn, punctured, perforated, etc.) during installation, it may be possible to repair it by cutting a patch to fit over the damaged area. The patch shall be obtained from a new GCL roll and shall be cut to size such that a minimum overlap of 12 inches (300 mm) is achieved around all of the damaged area. Dry bentonite mastic should be applied around the damaged area prior to placement of the patch. It may be desirable to use an adhesive to affix the patch in place so that it is not displaced during cover placement.

3.08 Cover Placement

A. Cover soils shall be free of angular stones or other foreign matter which could damage the GCL. Cover soils should be approved the project Engineer with respect to particle size, uniformity and chemically compatibility. Cover soils with high concentrations of calcium (e.g., limestone, dolomite) are not acceptable.

B. Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot (300 mm) of cover shall be maintained between the equipment tires/tracks and the GCL at all times during the covering process. For frequently trafficked areas or roadways, a minimum cover thickness of 2 feet (600 mm) is required.

C. Soil cover should be placed in a manner that prevents the soil from entering the GCL overlap zones. The Contractor shall place the soil in a manner that does damage the GCL.

END OF SECTION

SECTION 02910
DRYLAND SEEDING AND FERTILIZING

PART I GENERAL

1.01 SECTION INCLUDES

The work described in this section shall consist of providing all labor, services, seed, fertilizer, and equipment to seed and establish grasses in the drainage channels.

1.02 RELATED SECTIONS

Section 02200 - Excavation.
Section 02270 - Drainage Ditches.
Section 02710 - Geosynthetic Materials.

1.03 SUBMITTALS

Submit the following to ARCO:

A. Certificates of Compliance: Furnish certification that standards specified herein are met and provide all seed tags to ARCO.

PART 2 PRODUCTS

2.01 GRASS SEED

Grass seed shall be a mixture of the species and variety specified below. The seed mix shall be as follows:

SPECIES	APPLICATION RATE (lbs pure live seed per acre)
Agropyron smithii (Western wheatgrass)	8.0
Agropyron trachycaulum (Slender wheatgrass)	5.5
Bouteloua curtitendula (Sideoats grama)	4.5
Bouteloua gracilis (Blue grama)	1.5
Oryzopsis hymenoides (Indian ricegrass)	4.0

In addition, 10 pounds per acre of REGREEN™ or equal non-native annual grass shall be applied.

Seed shall comply with and be labeled in accordance with the Montana Seed Law and shall be free of all prohibited noxious weed seed or any other weed seed prohibited by state of local ordinance. Seed shall have been grown in the North American Continent above 41 degrees latitude. All seed shall be standard grade adapted to Montana conditions.

2.02 FERTILIZER

Urea fertilizer (46:0:0 N:P:K) shall be applied at a rate of 120 pounds per acre (equivalent of 50 pounds per acre of nitrogen).

2.03 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Storage: Store all seed and fertilizer properly. Any seed or fertilizer damaged during such storage shall be replaced by the Contractor at his expense.

PART 3 EXECUTION

3.01 TIME OF SEEDING

The seeding shall be conducted prior to June 1 or after October 15, unless otherwise approved by ARCO.

3.02 PREPARATION OF SEEDBED

After finish grading is approved by ARCO, all channel slopes to receive seed shall be raked to true lines, free from large humps, ridges and depressions.

3.03 SEEDING

Seeding for the drainage channels shall be done by drill seeding methods at the rates specified above. If broadcast seeding methods are used, the application rates identified in Section 2.01 shall be doubled.

3.04 FERTILIZING

Fertilizer shall be applied concurrently with the seed using broadcast methods at the

specified rates.

3.05 EROSION CONTROL MAT

Erosion control mat shall be installed immediately after seeding in accordance with Section 02710.

3.06 ESTABLISHMENT

A. The Contractor shall be responsible for the proper care and maintenance of the seeded areas during the period of construction.

B. Repair - If at any time before completion and acceptance of the entire work covered by this contract, any portion of the channel surface becomes gullied or otherwise damaged following seeding and erosion control mat installation, the affected portion shall be repaired to re-establish the condition and grade of the soil prior to seeding and shall then be reseeded and new erosion control mat installed at the Contractor's expense.

END OF SECTION

SECTION 02920
MULCH

PART I GENERAL

1.01 SECTION INCLUDES

This section includes product specifications for covering and processing specified seeded areas with vegetative mulch.

1.02 RELATED SECTIONS

Section 02910 - Dryland Seeding and Fertilizing

1.03 SUBMITTALS

Submit the following to ARCO:

A. Manufacturer/Supplier's specifications and material content for mulch products.

B. Manufacturer/Supplier's recommended application methods and rate.

C. "Weed Seed Free" Certification.

PART 2 PRODUCTS

2.01 VEGETATIVE MULCH

The type of mulch material used shall be composed of wheat straw, rye straw, or barley straw.

A. Straw mulch shall be clean grain straw, shall be "Montana Noxious Weed Seed Free" straw and shall not contain greater than 5% cereal seed by weight (i.e., seed heads). Written confirmation from a certified supplier will be required.

B. Chopped or ground material is not acceptable. The mulch material is not acceptable if it is musty, moldy or rotted, or if it contains seedbearing stalks of noxious weeds. It shall be free of stones, dirt, roots, stumps, or other foreign objects.

PART 3 EXECUTION

3.01 CONSTRUCTION REQUIREMENTS

A. Mulch must be applied as temporary erosion control to all areas after finished-grade is achieved and approved by ARCO. Mulch shall not be applied in the presence of free surface water, but may be applied upon damp ground. Mulch shall not be applied to snow-covered ground surfaces. Mulching shall not be done during adverse weather conditions or when wind prevents uniform distribution. Application shall be in a manner to not seriously disturb the seedbed surface. The Contractor shall remove any vehicle/equipment tracks on the seedbed prior to final mulching. The Contractor shall use a rake, small harrow, or other acceptable means to remove the tracks.

B. Vegetative mulch shall be applied after seeding and fertilizing is completed. The mulch shall be applied in a uniform manner by a mulch spreader at a minimum rate of 3,000 pounds per acre. The mulch spreader shall be designed specifically for this type of work. The vegetative material shall be fed into the mechanical mulch spreader at an even, uniform rate.

C. Mulch shall be anchored into the seedbed by using a mulch crimper. The mulch crimper, specifically designed for this type of work, shall have round, flat (not angled), notched blades of the following approximate dimensions: 1/4-inch thick by 18-inches in diameter and spaced 8-inches apart. The crimper shall have sufficient weight to force the vegetative mulch a minimum of 3-inches into the soil and shall be equipped with disc scrapers. All mulch crimping shall be done perpendicular to the flowline of the slope.

END OF SECTION

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Grove Creek
Clark Tailing Outfall
F.P. Crowley

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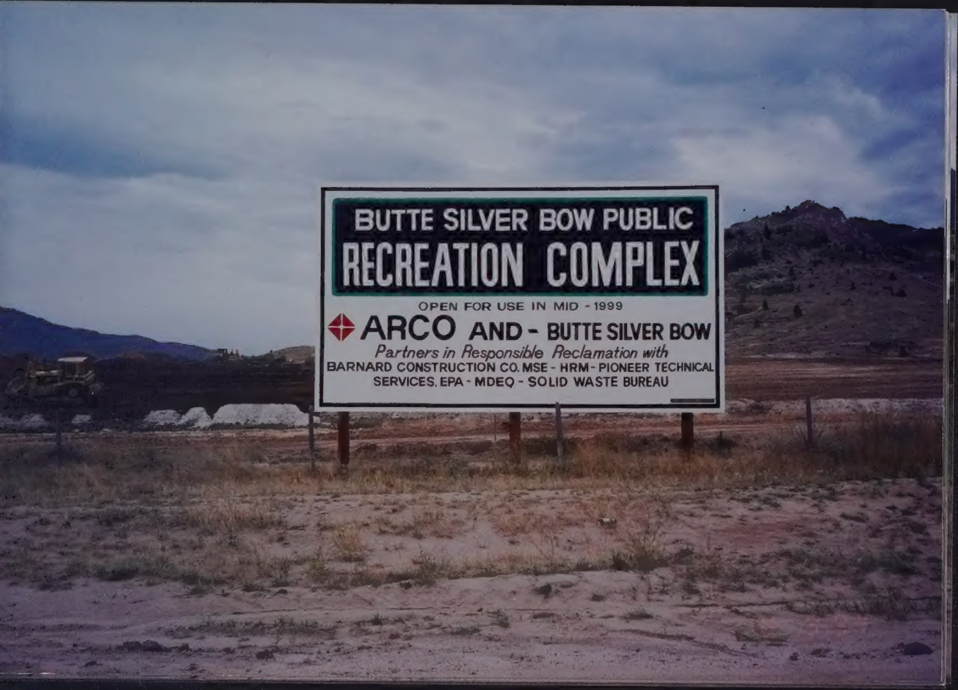
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RECREATION COMPLEX
OPEN FOR USE IN MID - 1999
ARCO AND - BUTTE SILVER BOW
Partners in Responsible Reclamation with
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SERVICES. EPA - MDEQ - SOLID WASTE BUREAU

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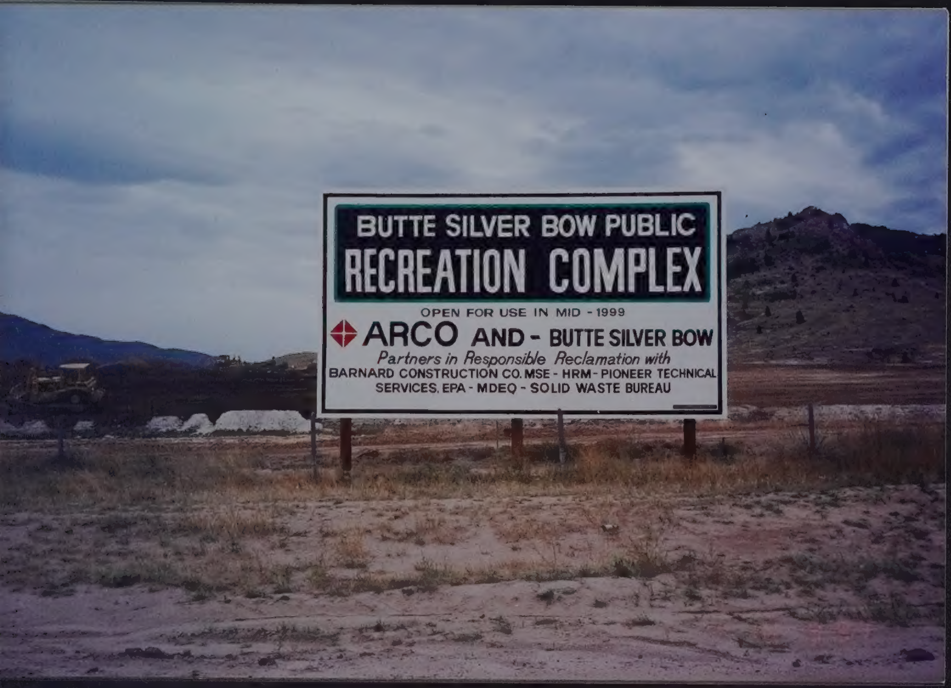
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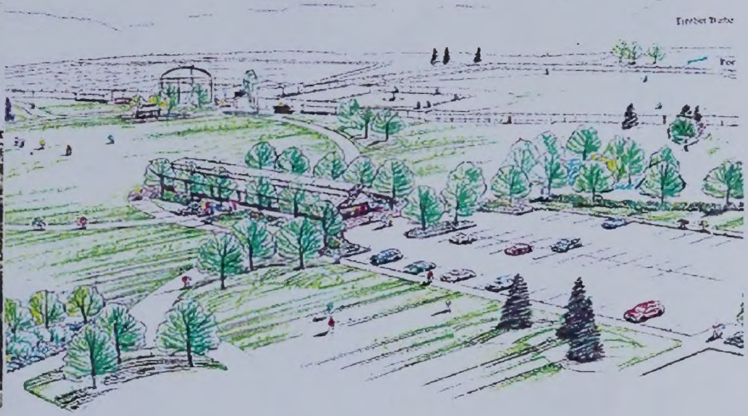
2D

County Silver Bow
Facility & # Old Butte

[✓ Closure]
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Other:

Landfarm
Liner
Methane
O & M
Run - On



Another new beginning for Butte.

Please join us on February 25 for a brief ceremony to commemorate the start of construction of the new recreational complex near **Timber Butte.** This new park will have baseball and football fields, concessions and many other features. It will be a special place dedicated to Butte's youth.

This project is just one of many cooperative efforts among local citizens, government officials and ARCO to enhance our Montana lifestyle; as we work together to reclaim for future generations land once disturbed by a century of mining activity.

Soon, the old Clark Tailings area will be transformed into a 40 acre public recreation complex over what once was the old city landfill and mine waste. At the conclusion of work, the park will be permanently deeded to Butte-Silver Bow.

We'll be gathering at the site of the new recreational complex, located west of South Montana Street at Beef Trail Road at 11:00. We would be honored by your presence as this next page of Butte's spirit of cooperation and innovation in addressing environmental challenges is turned.

ARCO

Partners In Responsible Reclamation

ARCO Environmental Remediation L.L.C.
307 East Park Street Suite 400
Anaconda, Montana 59711

ANACONDA MT
FEB 18 '00
U.S. POSTAGE
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PB METER
6056650

Pat Crowley
MDEQ Solid Waste
Box 200901
Helena Montana 59620-0901

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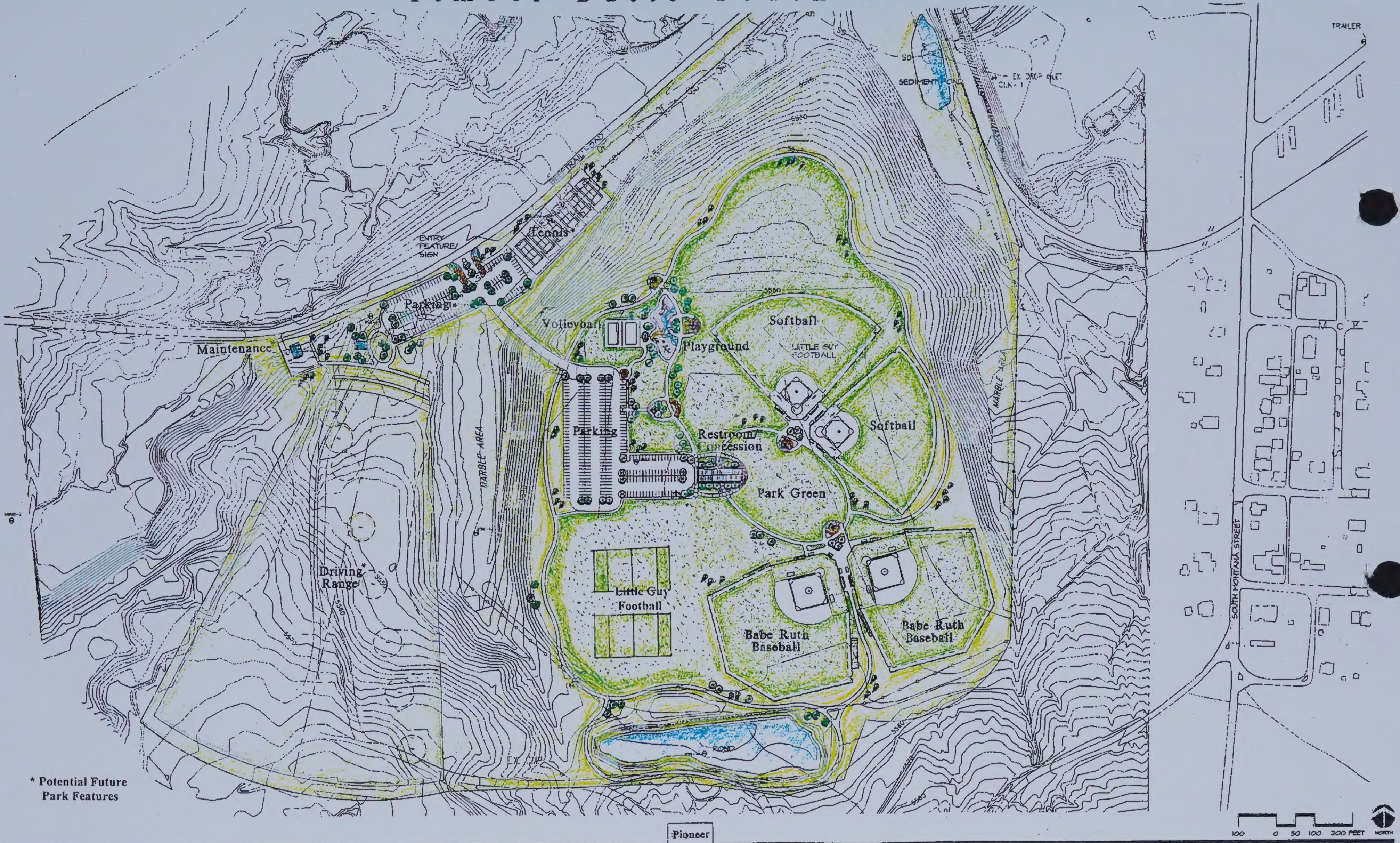
FEB 22 2000
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Master Plan

Timber Butte Youth Park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Parking*
Maintenance
Volleyball
Playground
Softball
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Softball
Parking
Restroom/ Concession
Park Green
MARBLE AREA
MARBLE AREA
Driving* Range
Little Guy Football
Babe Ruth Baseball
Babe Ruth Baseball
POND
SOUTH MONTANA STREET
100 0 50 100 200 FEET
NORTH

* Potential Future Park Features

Pioneer • EDAW

ARCO ENVIRONMENTAL REMEDIATION, L.L.C.

ARCO
ARCO Environmental Remediation, L.L.C.
307 East Park Street, Suite 400
Anaconda, Montana 59711
Telephone 406 563 5211
Facsimile 406 563 8269

Old Butte L.F.
Clark Tailings
Closure.

RECEIVED
JUL 24 1998
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

County Silver Bow
Facility & # Butte 20
[✓ Closure]
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Other:
Landfarm
Liner
Methane
O & M
Run - On

July 22, 1998

F. Patrick Crowley
Solid Waste Program Manager
Montana Department of Environmental Quality
P.O. Box 200901
Helena, Montana 59620-0901

RE: Infiltration Barrier Materials at Clark Tailings

Dear Pat:

As recently discussed with Brad Archibald on the phone, it appears that there may be a deficit of low permeability soils available from the pre-approved (Hollow) borrow source for the infiltration barrier layer of the Clark Tailings cap. At this time, we project a shortfall of 5,000 to 10,000 cubic yards. We continue to search for additional low permeability materials from the Hollow borrow source, and will use these materials to the maximum extent possible. However, if we do run short of materials, we would like to utilize low permeability materials from the existing Butte-Silver Bow landfill.

I have attached available materials data on the proposed secondary borrow source. These data are from the *Butte-Silver Bow Municipal Solid Waste Landfill Hydrogeologic Evaluation of Landfill Performance, Addendum #1* (Special Resource Management, February 2, 1994). These data indicate consistent, fine-grained soils at the site. Laboratory permeability tests on composite samples indicate permeabilities ranging from 3.0E-07 cm/sec to 4.6E-07 cm/sec. As we discussed this morning, in situ permeability testing of these materials is not required considering the fact that they would account for a very small portion of the infiltration barrier layer and the laboratory testing indicated materials far less permeable than the 1.0E-05 cm/sec regulatory requirement. Brad Archibald, Project Engineer, and you have agreed this is appropriate for this situation.

ARCO will conduct moisture-density relationship (Proctor) tests on these soils to determine the compaction of the laboratory permeability samples. Also, gradation, Atterberg limits, and compaction testing of the materials will be conducted during construction, in accordance with the approved construction quality assurance plan, to assure the quality of the materials and their installation.

If ARCO does use this borrow source, they will secure approval from Butte-Silver Bow prior to removing materials to the Clark Tailings site. Chris Sanchez, On-site Construction Manager, or Brad Archibald will notify you prior to use of this material at the site.

If you have any questions or comments, please give me a call at 563-5211 x413 or Brad Archibald at 782-5177.

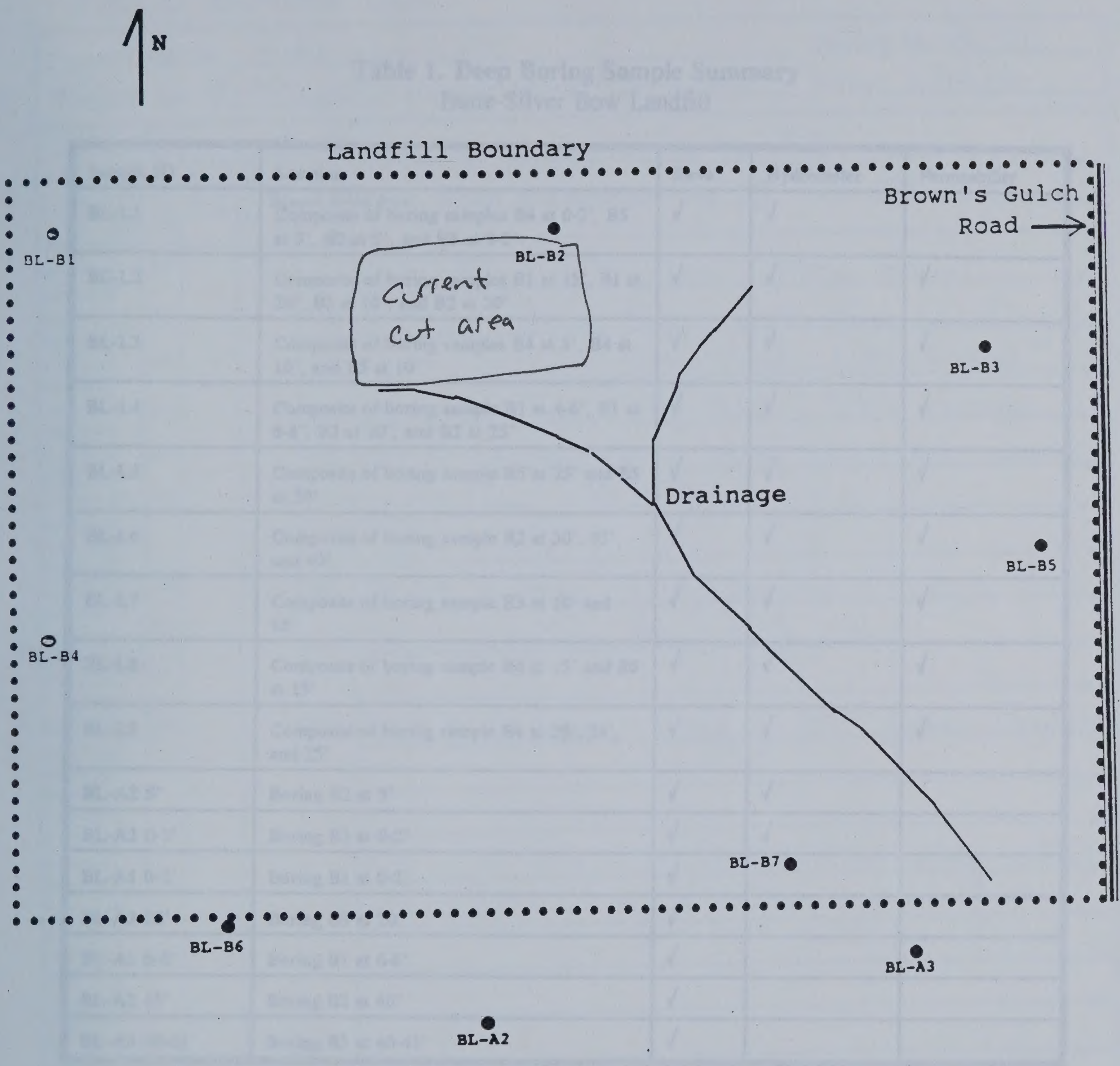
Sincerely,

Chuck Stilwell

Chuck Stilwell, P.E.
Project Manager

Enclosures (boring logs, gradation tests, permeability tests)

cc: Brad Archibald, Pioneer Technical Services
Chris Sanchez, Anderson Engineering


N
Landfill Boundary
Brown's Gulch Road
BL-B1
BL-B2
Current cut area
BL-B3
Drainage
BL-B5
BL-B4
BL-B7
BL-B6
BL-A3
BL-A2

● Soil Borings

Figure A-1. Soil Boring Locations

Special Resource Management, Inc.
Specialists in Waste and Resource Management Technology

Table 1. Deep Boring Sample Summary
Butte-Silver Bow Landfill

Sample ID	Location	Sieve	Hydrometer	Permeability
BL-L1	Brown sandy SILT Composite of boring samples B4 at 0-2', B5 at 5', B2 at 5', and B3 at 0-2'	√	√	
BL-L2	Composite of boring samples B1 at 15', B1 at 20', B2 at 10', and B2 at 20'	√	√	√
BL-L3	Composite of boring samples B4 at 5', B4 at 10', and B5 at 10'	√	√	√
BL-L4	Composite of boring sample B1 at 4-6', B1 at 6-8', B2 at 20', and B2 at 25'	√	√	√
BL-L5	Composite of boring sample B5 at 25' and B5 at 30'	√	√	√
BL-L6	Composite of boring sample B2 at 30', 35', and 40'	√	√	√
BL-L7	Composite of boring sample B3 at 10' and 15'	√	√	√
BL-L8	Composite of boring sample B4 at 15' and B5 at 15'	√	√	√
BL-L9	Composite of boring sample B4 at 20', 24', and 25'	√	√	√
BL-A2 5'	Boring B2 at 5'	√	√	
BL-A3 0-2'	Boring B3 at 0-2'	√	√	
BL-A1 0-2'	Boring B1 at 0-2'	√		
BL-A3 20'	Boring B3 at 20'	√		
BL-A1 6-8'	Boring B1 at 6-8'	√		
BL-A2 45'	Boring B2 at 45'	√		
BL-A3 40-41'	Boring B3 at 40-41'	√		

FIELD BORING LOG

Project Name Butte Land fill Boring No. BL-61
Project No. 01-976-05 Logger's Name D. Erickson Date 11/14/90

Method of Advance: Auger to 53' Wash to ____
Free Water Encountered: Yes ☐ No ☑ at ____

DEPTH	SAMPLE	SYMBOL*	HNU PPM	TIME IN MIN.	BLOWS PER FOOT	
		sm				0-2 Brn Silty Sand, little Gravel
		mL			46	5-7 Lt Brn Silt with Sand and Clay
10		sm			62	10-12 Lt. Brn. Silty Sand, Little Gravel
		sm			58	15-17 Lt Brn. Silty Sand, Little Gravel
20		sm			52	20-22 Lt. Brn-Grey Silty sd, Little Gravel
		sm			40	25-27 Grey Silty Sand
30		sm			40	30-32 Grey Silty Sand
		sm			62	35-37 Lt Grey-Brn Silty Sand
40		CL			82	45-47 Lt. Brn. Clayey Silt, trace Organics
50						
		CL				53 Lt Brn Silt, Little Clay T.D.

* Unified Soil Classification System

BLOW PER FOOT	DESCRIPTIVE TERM
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Firm
31 - 50	Dense
Over 50	Very Dense

POCKET PEN.	DESCRIPTIVE TERM
Less than 0.25	Very Soft
0.25 to 0.50	Soft
0.50 to 1.00	Medium
1.00 to 2.00	Stiff
2.00 to 4.00	Very Stiff
4.00 and Higher	Hard

Time	Depth to Water	Time	Depth to Water

FIELD BORING LOG

Project Name	Butte Landfill	Boring No.	BL-B2
Project No. 01-976-05	Logger's Name D. Erickson	Date	11/14/90

Method of Advance: Auger to 62' Wash to ______

Free Water Encountered: Yes ☐ No ☑ at ______

DEPTH	SAMPLE	SYMBOL*	HNU PPM	TIME IN MIN.	BLOWS PER FOOT	
		ML				0-2 Brn Sandy Silt, Little Clay
		Sm			48	5-7 Lt. Brn Silty Sand
10		Sm			70	10-12 Lt Brn Silty Sand
		CL			58	15-17 Lt Brn Clayey Silt
20						
		Sm				20-22 Lt Brn silty Sand
		CL			80	25-27 Brn Clayey Silt
30		SC				30-32 Lt Brn Clayey Sd, Little Silt
		CL				35-37 Brn Clayey Silt
		CL				40-42 Brn Clayey Silt, Little Sand
40		CL				45-47 Brn Clayey Silt / Brn Sandy Silt
50		CL				50-52 Brn Clayey Silt
		CL				55-57 Brn Clayey Silt / Brn Sandy Silt
60		Sm				60-62 Lt. Brn. Silty Sand, Little Gravel
						T.D.

*Unified Soil Classification System

BLOW PER FOOT	DESCRIPTIVE TERM
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Firm
31 - 50	Dense
Over 50	Very Dense

POCKET PEN.	DESCRIPTIVE TERM
Less than 0.25	Very Soft
0.25 to 0.50	Soft
0.50 to 1.00	Medium
1.00 to 2.00	Stiff
2.00 to 4.00	Very Stiff
4.00 and Higher	Hard

Time	Depth to Water	Time	Depth to Water

FIELD BORING LOG

Project Name Butte Landfill Boring No. BL-B3
Project No. 01-976-05 Logger's Name D. Erickson Date 11/14/90

Method of Advance: Auger to 87' Wash to
Free Water Encountered: Yes ☐ No ☑ at

DEPTH	SAMPLE	SYMBOL*	HNU PPM	TIME IN MIN.	BLOWS PER FOOT	
		mL				0-2 Brn Silt with Sand and Clay
		mL			26	3-5 Lt. Brn. Sandy Silt
10		CL			42	8-10 Brn Clayey Silt, Little sand
		sm			48	13-15 Brn Silty Sand, some silt Layers
20					56	18-20 Brn Clayey Silt, Trace Organics
		CL				23-25 Brn Clayey Silt
30		CL mL			66	28-30 Lt Brn. Silt with sand and Clay
		sm			66	33-35 Lt Brn Silty Sand
40		sm			64	38-40 Lt. Brn. Silty Sand
		CL				48-50 Dk Brn Clayey Silt
50						
		CL				58-60 Brn Clayey Silt
60						
70		mL				68-70 Brn Sandy Silt with Clay
		sm				78-80 Lt Brn-Gray Silty Sand
80						
		sm				87' Lt Brn Silty Sand T.D.
						* Unified Soil Classification System

BLOW PER FOOT	DESCRIPTIVE TERM
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Firm
31 - 50	Dense
Over 50	Very Dense

POCKET PEN.	DESCRIPTIVE TERM
Less than 0.25	Very Soft
0.25 to 0.50	Soft
0.50 to 1.00	Medium
1.00 to 2.00	Stiff
2.00 to 4.00	Very Stiff
4.00 and Higher	Hard

Time	Depth to Water	Time	Depth to Water

FIELD BORING LOG

Project Name Butte Landfill Boring No. BL-B4

Project No. 01-976-05 Logger's Name D. Ericksen Date 11/14/90

Method of Advance: Auger to 67' Wash to ______

Free Water Encountered: Yes ☐ No ☑ at ______

DEPTH	SAMPLE	SYMBOL*	HNU PPM	TIME IN MIN.	BLOWS PER FOOT	
		ML				0-2 Brn Sandy Silt
		ML			38	5-7 Lt Brn Sandy Silt, some Pebbles
		mL				
10		sm			94	10-12 Lt Brn Sandy Silt, Little Clay
		mL Sm			44	15-17 Interbedded Brn Sandy Silts and
						Brn Silty Sands, Little Clay
20		mL			38	20-22 Red-brn. Sandy Silt, Little Clay
		sm			54	25-27 Lt Brn Silty Sand
30		mL			48	30-32 Brn Silt, some sand
		SP				40-42 Grey Granite Sand, with Gravel
40		SP				43-45 Grey Granite Sand, with Gravel
50						
		mL				55-57 Brn Silt, Little Clay
		SP				58-60 Grey Granite Sand, Little Gravel
60						
						67' T.D.
						* Unified Soil Classification System

BLOW PER FOOT	DESCRIPTIVE TERM
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Firm
31 - 50	Dense
Over 50	Very Dense

POCKET PEN.	DESCRIPTIVE TERM
Less than 0.25	Very Soft
0.25 to 0.50	Soft
0.50 to 1.00	Medium
1.00 to 2.00	Stiff
2.00 to 4.00	Very Stiff
4.00 and Higher	Hard

Time	Depth to Water	Time	Depth to Water

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: 9-11-90

Project: B90-164 LABORATORY TESTING
Special Resource Management

Reported To: Special Resource Management
ATTN: David J. Erickson
P.O. BOX 4168
Butte, MT. 59702

SAMPLE DATA:

Sample No.: BL-L2
Description: Clayey Sand, fine to coarse grained, low plasticity, with silt.
LL: % PL: % PI: % Passing #200: 37.3 % Passing 0.002 mm: 8.0 %
Unified Classification: SC Textural Classification:
Maximum Dry Density (ASTM D698): pcf Optimum Moisture Content: %

SPECIMEN DATA:

Molding MC: 19.3 %
Dry Density: 105.5 pcf
Relative Compaction: -0.0 %
Sample Diameter: 72.9 mm
Height: 39.0 mm
Cross-Section Area: 41.74 sq. cm
Standpipe Area: 1.0 sq. cm
Confining Pressure: 5.0 psi

TEST RESULTS:

Run	Initial Head, cm.	Final Head, cm.	Time min.	Permeability cm/sec	Permeability ft/min
7	279.0	264.8	233	3.5 E-07	
8	279.0	262.5	300	3.2 E-07	
9	279.0	254.0	421	3.5 E-07	
			Average Permeability	3.4 E-07	6.7 E-07

Remarks:

BRAUN
ENGINEERING TESTING

BRAUN ENGINEERING TESTING
OF MONTANA, INC.

Nathan P. Boeshans
NATHAN P. BOESHANS
PROJECT ENGINEER

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: 9-11-90

Project: B90-164 LABORATORY TESTING
Special Resource Management

Reported To: Special Resource Management
ATTN: David J. Erickson
P.O. BOX 4168
Butte, MT. 59702

SAMPLE DATA:

Sample No.: BL-L3

Description: Clayey Sand, fine to coarse grained, low plasticity, with silt.

LL: % PL: % PI: % Passing #200: 50.4 % Passing 0.002 mm: 9.3 %

Unified Classification: SC Textural Classification:

Maximum Dry Density (ASTM D698): pcf Optimum Moisture Content: %

SPECIMEN DATA:

Molding MC: 22.8 %
Dry Density: 96.2 pcf
Relative Compaction: -0.0 %
Sample Diameter: 72.9 mm
Height: 48.0 mm
Cross-Section Area: 41.74 sq. cm
Standpipe Area: 1.0 sq. cm
Confining Pressure: 5.0 psi

TEST RESULTS:

Run	Initial Head, cm.	Final Head, cm.	Time min.	Permeability cm/sec	Permeability ft/min
7	277.0	267.0	233	3.0 E-07	
8	277.0	264.0	300	3.1 E-07	
9	277.0	259.0	421	3.1 E-07	
			Average Permeability	3.1 E-07	6.1 E-07

Remarks:

BRAUN
ENGINEERING TESTING

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OF MONTANA, INC.

Nathan P. Boeshans
NATHAN P. BOESHANS
PROJECT ENGINEER

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: 9-11-90

Project: B90-164 LABORATORY TESTING
Special Resource Management

Reported To: Special Resource Management
ATTN: David J. Erickson
P.O. BOX 4168
Butte, MT. 59702

SAMPLE DATA:

Sample No.: BL-L4

Description: Clayey Sand, fine to coarse grained, low plasticity, with silt.

LL: % PL: % PI: % Passing #200: 33.7 % Passing 0.002 mm: 6.7 %

Unified Classification: SC Textural Classification:

Maximum Dry Density (ASTM D698): pcf Optimum Moisture Content: %

SPECIMEN DATA:

Molding MC: 17.3 %
Dry Density: 108.2 pcf
Relative Compaction: %
Sample Diameter: 72.9 mm
Height: 65.6 mm
Cross-Section Area: 41.74 sq. cm
Standpipe Area: 1.0 sq. cm
Confining Pressure: 5.0 psi

TEST RESULTS:

Run	*Initial Head, cm.*	*Final Head, cm.*	*Time min.*	*Permeability cm/sec*	*Permeability ft/min*
7	275.4	266.0	233	3.9 E-07	
8	275.4	262.0	300	4.4 E-07	
9	275.4	258.0	421	4.1 E-07	
			Average Permeability	4.1 E-07	8.0 E-07

Remarks:

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OF MONTANA, INC.

Nathan P. Boeshans
NATHAN P. BOESHANS
PROJECT ENGINEER

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: 9-11-90

Project: B90-164 LABORATORY TESTING
Special Resource Management

Reported To: Special Resource Management
ATTN: David J. Erickson
P.O. BOX 4168
Butte, MT. 59702

SAMPLE DATA:

Sample No.: BL-L5

Description: Silty Sand, fine to coarse grained, sl. plastic, a little clay.

LL: % PL: % PI: % Passing #200: 24.1 % Passing 0.002 mm: 6.7 %

Unified Classification: SM Textural Classification:

Maximum Dry Density (ASTM D698): pcf Optimum Moisture Content: %

SPECIMEN DATA:

Molding MC: 15.3 %
Dry Density: 115.2 pcf
Relative Compaction: %
Sample Diameter: 72.9 mm
Height: 60.0 mm
Cross-Section Area: 41.74 sq. cm
Standpipe Area: 1.0 sq. cm
Confining Pressure: 5.0 psi

TEST RESULTS:

Run	*Initial Head, cm.*	*Final Head, cm.*	*Time min.*	*Permeability cm/sec*	*Permeability ft/min*
6	276.5	255.0	440	4.4 E-07	
7	276.5	253.0	460	4.6 E-07	
8	276.5	252.0	480	4.6 E-07	
			Average Permeability	4.6 E-07	9.0 E-07

Remarks:

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OF MONTANA, INC.

Nathan P. Boeshans
NATHAN P. BOESHANS
PROJECT ENGINEER

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: 9-11-90

Reported To: Special Resource Management
ATTN: David J. Erickson
P.O. BOX 4168
Butte, MT. 59702

Project: B90-164 LABORATORY TESTING
Special Resource Management

SAMPLE DATA:

Sample No.: BL-L6
Description: Silty Sand, fine to coarse grained, sl. plastic, a little clay.
LL: % PL: % PI: % Passing #200: 30.9 % Passing 0.002 mm: 10.7 %
Unified Classification: SM Textural Classification:
Maximum Dry Density (ASTM D698): pcf Optimum Moisture Content: %

SPECIMEN DATA:

Molding MC: 13.3 % Dry Density: 113.3 pcf Relative Compaction: %
Sample Diameter: 72.9 mm Height: 36.5 mm Cross-Section Area: 41.74 sq. cm
Standpipe Area: 1.0 sq. cm Confining Pressure: 5.0 psi

TEST RESULTS:

Run	Initial Head, cm.	Final Head, cm.	Time min.	Permeability cm/sec	Permeability ft/min
5	276.0	263.4	160	4.3 E-07	
6	276.0	255.0	270	4.3 E-07	
7	276.0	251.0	310	4.5 E-07	
			Average Permeability	4.3 E-07	8.4 E-07

Remarks:

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NATHAN P. BOESHANS
PROJECT ENGINEER

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: 9-11-90

Project: B90-164 LABORATORY TESTING
Special Resource Management

Reported To: Special Resource Management
ATTN: David J. Erickson
P.O. BOX 4168
Butte, MT. 59702

SAMPLE DATA:

Sample No.: BL-L7

Description: Silty Sand, fine to coarse grained, sl. plastic, a little clay.

LL: % PL: % PI: % Passing #200: 31.9 % Passing 0.002 mm: 8.0 %

Unified Classification: SM Textural Classification:

Maximum Dry Density (ASTM D698): pcf Optimum Moisture Content: %

SPECIMEN DATA:

Molding MC: 16.9 % Dry Density: 116.6 pcf Relative Compaction: %

Sample Diameter: 72.9 mm Height: 33.3 mm Cross-Section Area: 41.74 sq. cm

Standpipe Area: 1.0 sq. cm Confining Pressure: 5.0 psi

TEST RESULTS:

Run	Initial Head, cm.	Final Head, cm.	Time min.	Permeability cm/sec	Permeability ft/min
5	279.0	265.0	160	4.3 E-07	
6	279.0	255.0	270	4.4 E-07	
7	279.0	252.0	310	4.4 E-07	
			Average Permeability	4.4 E-07	8.6 E-07

Remarks:

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Nathan P. Boeshans
NATHAN P. BOESHANS
PROJECT ENGINEER

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: 9-11-90

Project: B90-164 LABORATORY TESTING
Special Resource Management

Reported To: Special Resource Management
ATTN: David J. Erickson
P.O. BOX 4168
Butte, MT. 59702

SAMPLE DATA:

Sample No.: BL-L8

Description: Clayey Sand, fine to coarse grained, low plasticity, with silt.

LL: % PL: % PI: % Passing #200: 64.0 % Passing 0.002 mm: 14.7 %

Unified Classification: SC Textural Classification:

Maximum Dry Density (ASTM D698): pcf Optimum Moisture Content: %

SPECIMEN DATA:

Molding MC: 21.5 %
Dry Density: 93.6 pcf
Relative Compaction: %
Sample Diameter: 72.9 mm
Height: 43.7 mm
Cross-Section Area: 41.74 sq. cm
Standpipe Area: 1.0 sq. cm
Confining Pressure: 5.0 psi

TEST RESULTS:

Run	Initial Head, cm.	Final Head, cm.	Time min.	Permeability cm/sec	Permeability ft/min
6	276.5	255.0	440	3.2 E-07	
7	276.5	254.0	460	3.2 E-07	
8	276.5	253.0	480	3.2 E-07	
			Average Permeability	3.2 E-07	6.3 E-07

Remarks:

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OF MONTANA, INC.

Nathan P. Boeshans
NATHAN P. BOESHANS
PROJECT ENGINEER

LABORATORY PERMEABILITY TEST (FALLING HEAD)

Date: 9-11-90

Project: B90-164 LABORATORY TESTING
Special Resource Management

Reported To: Special Resource Management
ATTN: David J. Erickson
P.O. BOX 4168
Butte, MT. 59702

SAMPLE DATA:

Sample No.: BL-L9

Description: Clayey Sand, fine to coarse grained, low plasticity, with silt.

LL: % PL: % PI: % Passing #200: 72.0 % Passing 0.002 mm: 16.0 %

Unified Classification: SC Textural Classification:

Maximum Dry Density (ASTM D698): pcf Optimum Moisture Content: %

SPECIMEN DATA:

Molding MC: 23.6 % Dry Density: 91.5 pcf Relative Compaction: %

Sample Diameter: 72.9 mm Height: 72.9 mm Cross-Section Area: 41.74 sq. cm

Standpipe Area: 1.0 sq. cm Confining Pressure: 5.0 psi

TEST RESULTS:

Run	*Initial Head, cm.*	*Final Head, cm.*	*Time min.*	*Permeability cm/sec*	*Permeability ft/min*
6	276.5	264.0	440	3.1 E-07	
7	276.5	263.5	460	3.0 E-07	
8	276.5	263.0	480	3.0 E-07	
			Average Permeability	3.0 E-07	5.9 E-07

Remarks:

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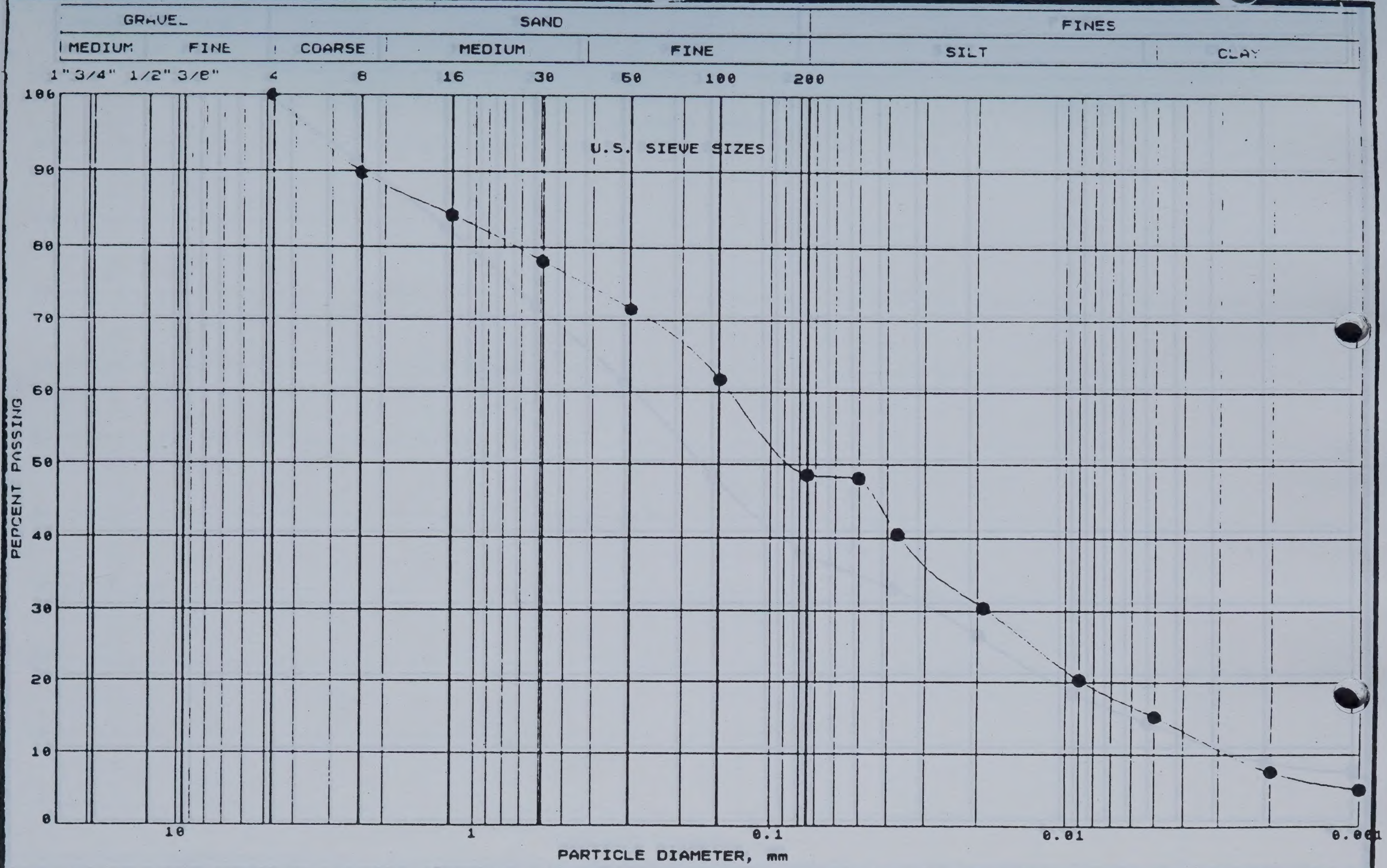
ENGINEERING TESTING

Nathan P. Boeshans
NATHAN P. BOESHANS
PROJECT ENGINEER

GRAIN SIZE ALYSIS CURVE



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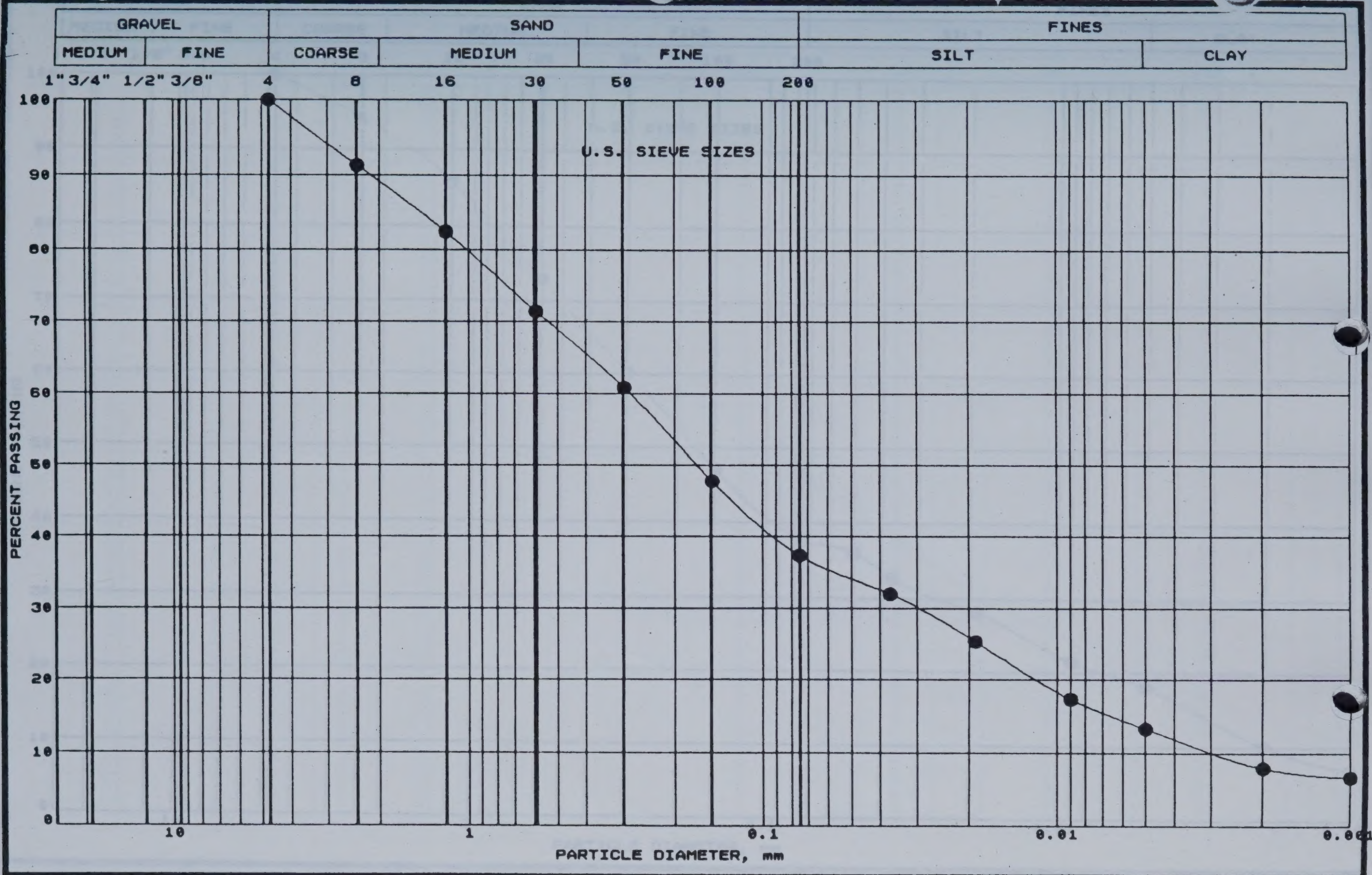
ENGINEERING TESTING

PROJECT: B90-164
Laboratory Testing
Butte, MT.

NOTES:
Sample BL-L1 0.00

GRAVEL	0.0
SAND	51.5
SILT	33.3
CLAY	15.2

GRAIN SIZE ANALYSIS CURVE



BRAUN
ENGINEERING TESTING

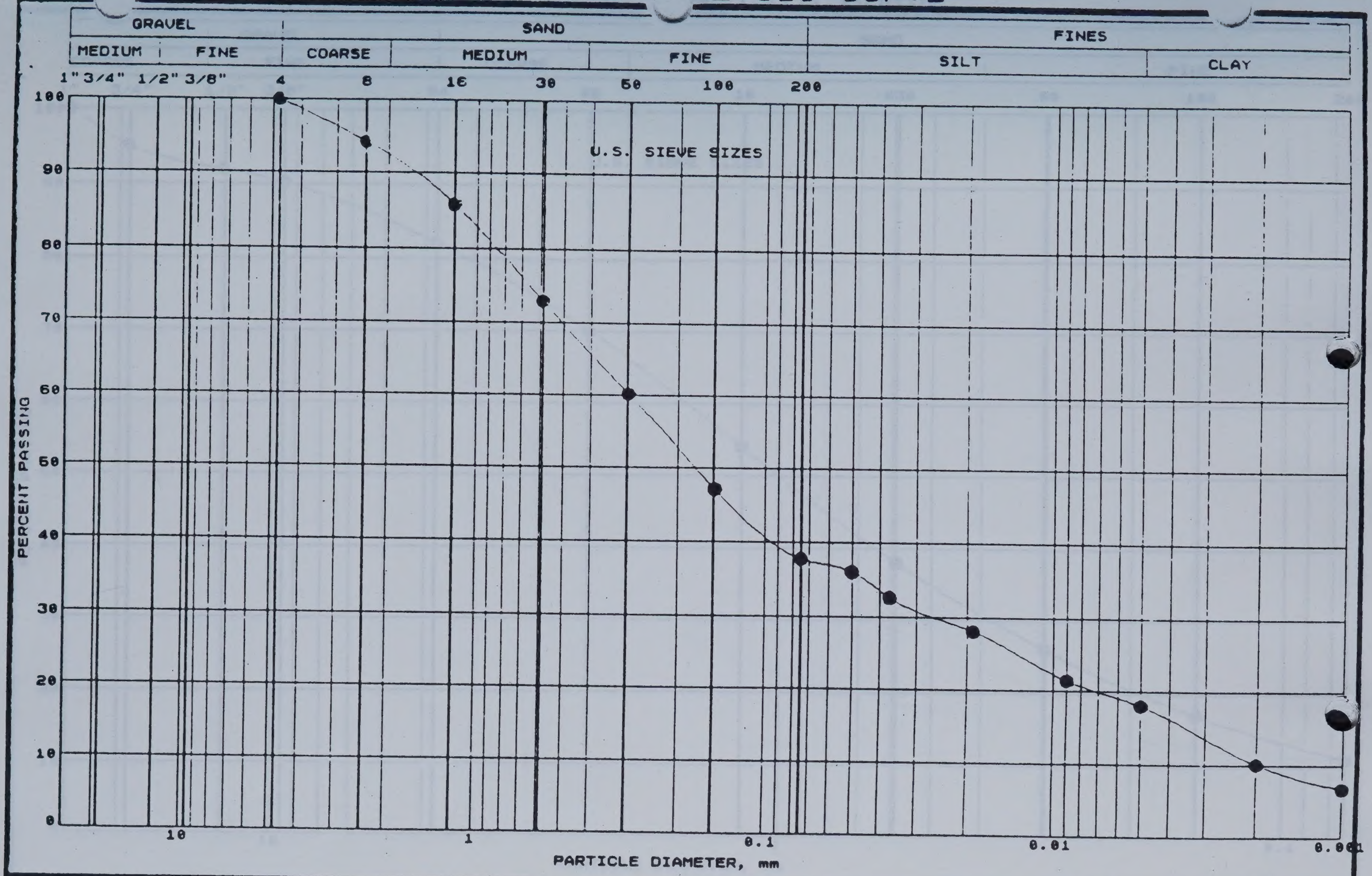
PROJECT: B90-164

Special Resource Management
Butte, MT.

NOTES:
Sample BL-L2 0.00

GRAVEL	0.0
SAND	62.7
SILT	24.0
CLAY	13.3

GRAIN SIZE ANALYSIS CURVE



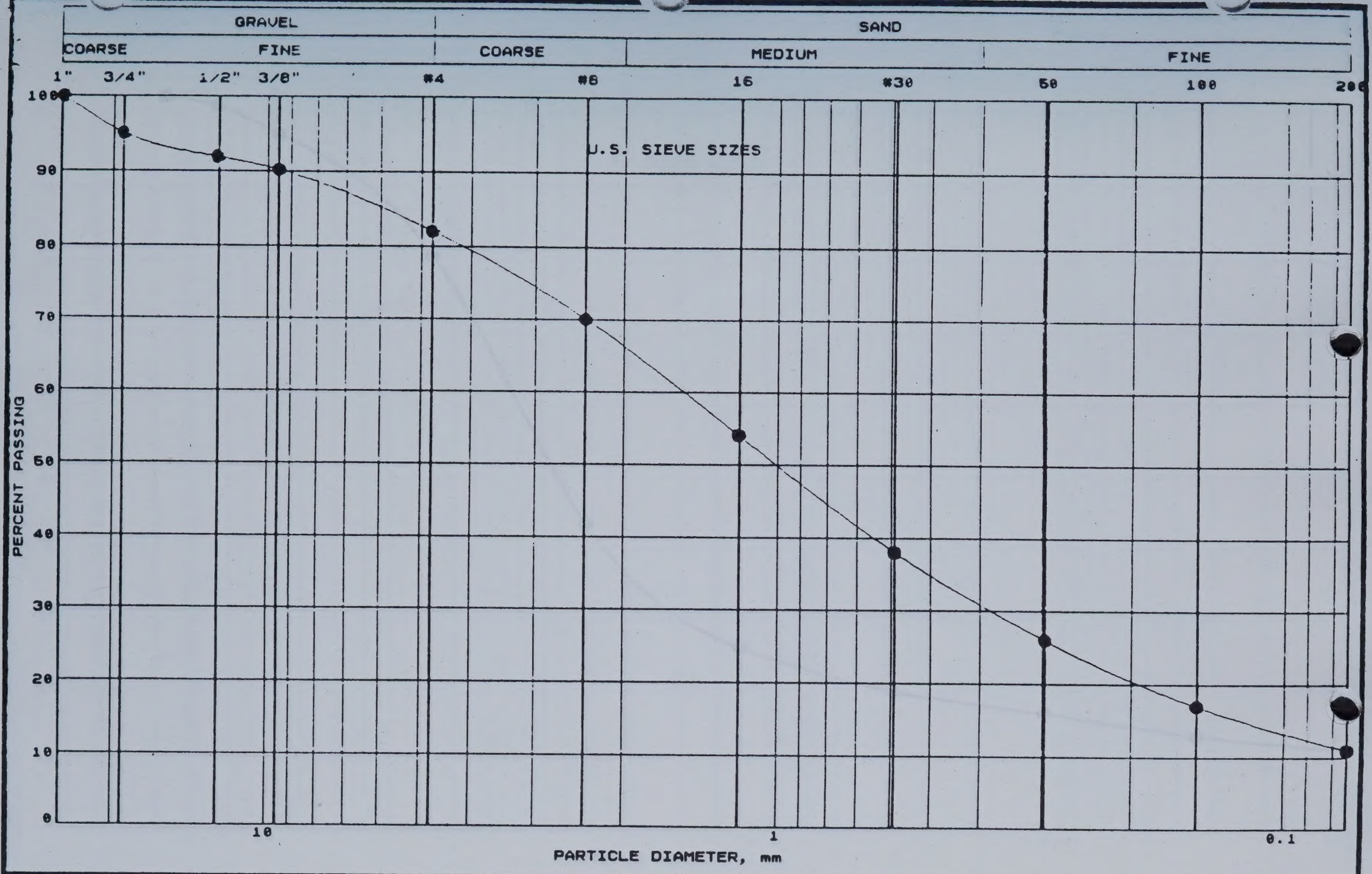
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Laboratory Testing
Butte, MT.

NOTES:
Sample BL-A3 0.00

GRAVEL	0.0
SAND	62.3
SILT	19.7
CLAY	18.0

GRAIN SIZE ALYSIS CURVE



BRAUN
ENGINEERING TESTING

PROJECT: B90-164

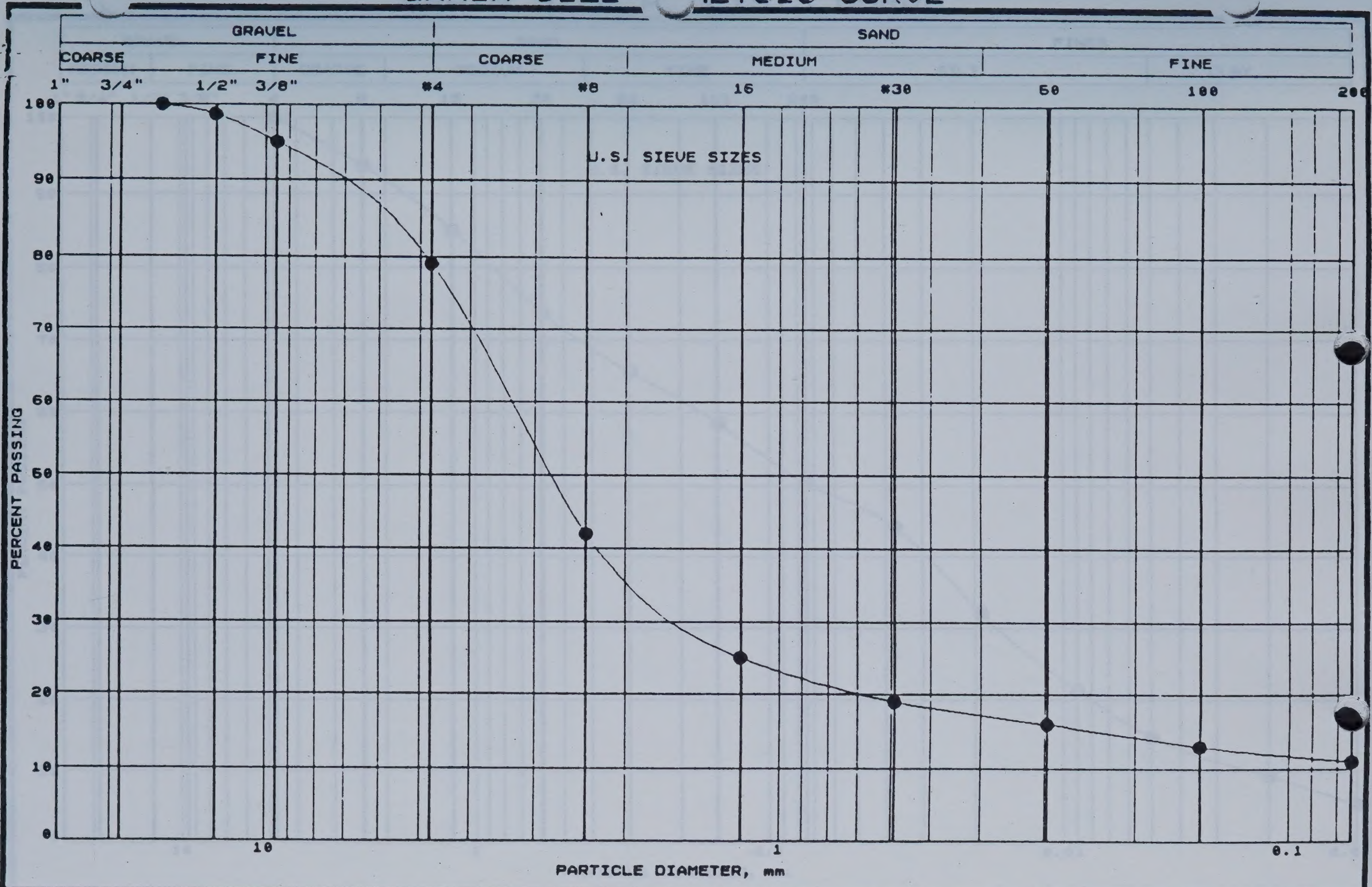
Laboratory Testing
Butte, MT.

NOTES:

Sample BL-A3 20.00

GRAVEL	18.0
SAND	71.0
[illegible]	[illegible]

GRAIN SIZE ALYSIS CURVE



BRAUN
ENGINEERING TESTING

PROJECT: B90-164

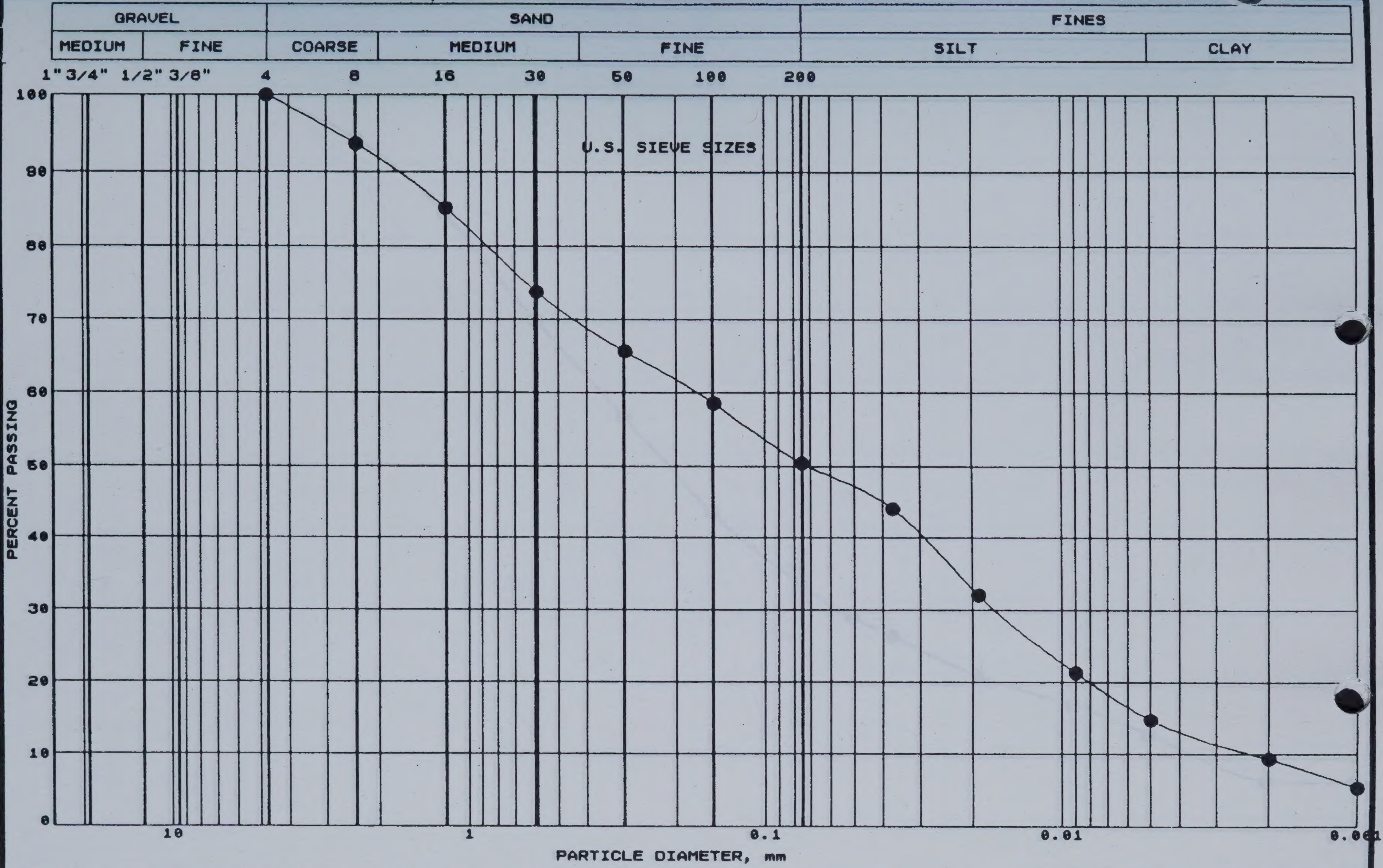
Laboratory Testing
Butte, MT.

NOTES:

Sample BL-A3 40.00

GRAVEL	21.0
SAND	68.0
[illegible]	[illegible]

GRAIN SIZE A LYSIS CURVE



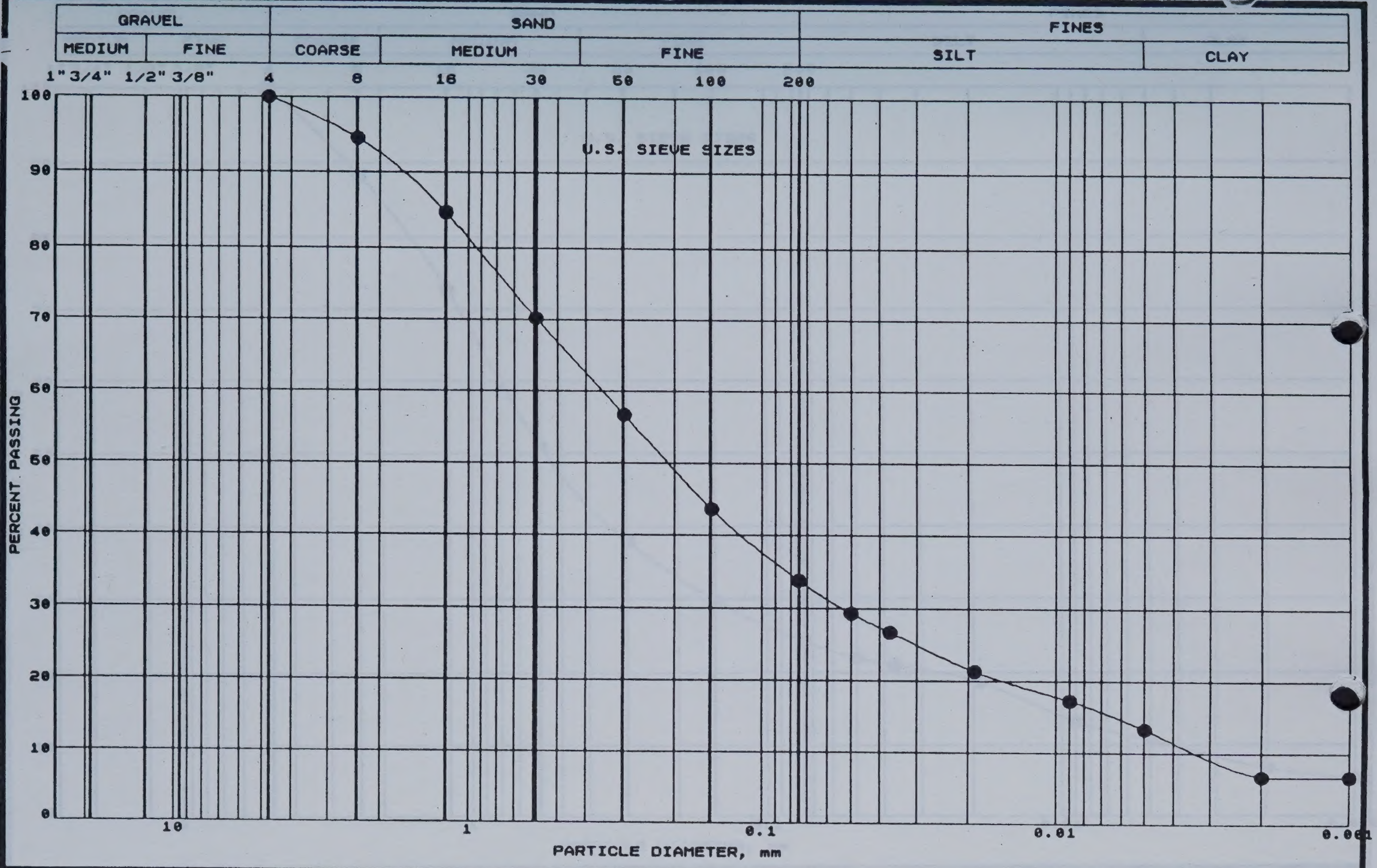
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Special Resource Management
Butte, MT.

NOTES:
Sample BL-L3 0.00

GRAVEL	0.0
SAND	49.6
SILT	35.7
CLAY	14.7

GRAIN SIZE ANALYSIS CURVE



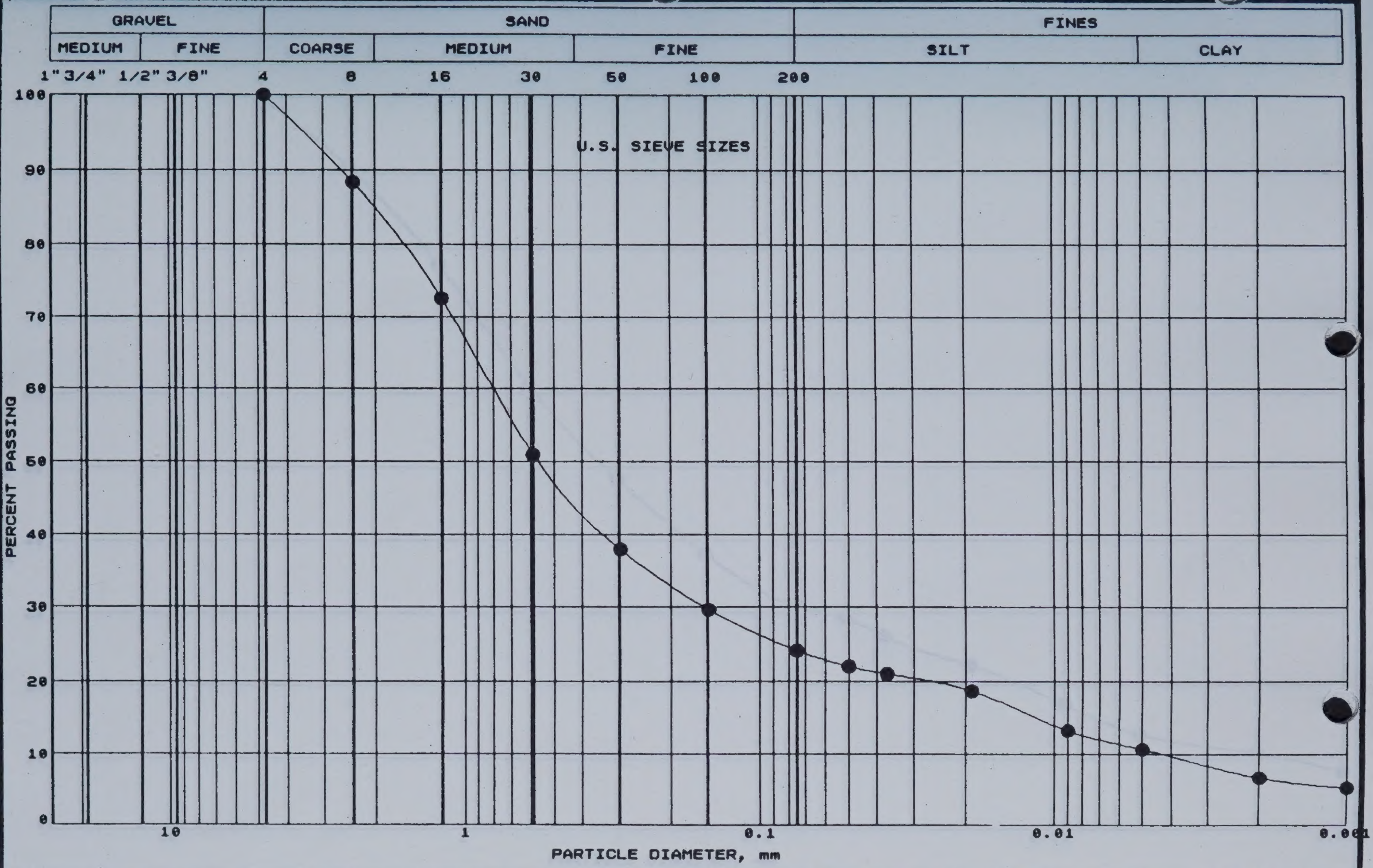
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Special Resource Management
Butte, MT.

NOTES:
Sample BL-L4 0.00

GRAVEL	0.0
SAND	66.3
SILT	20.4
CLAY	13.3

GRAIN SIZE ANALYSIS CURVE



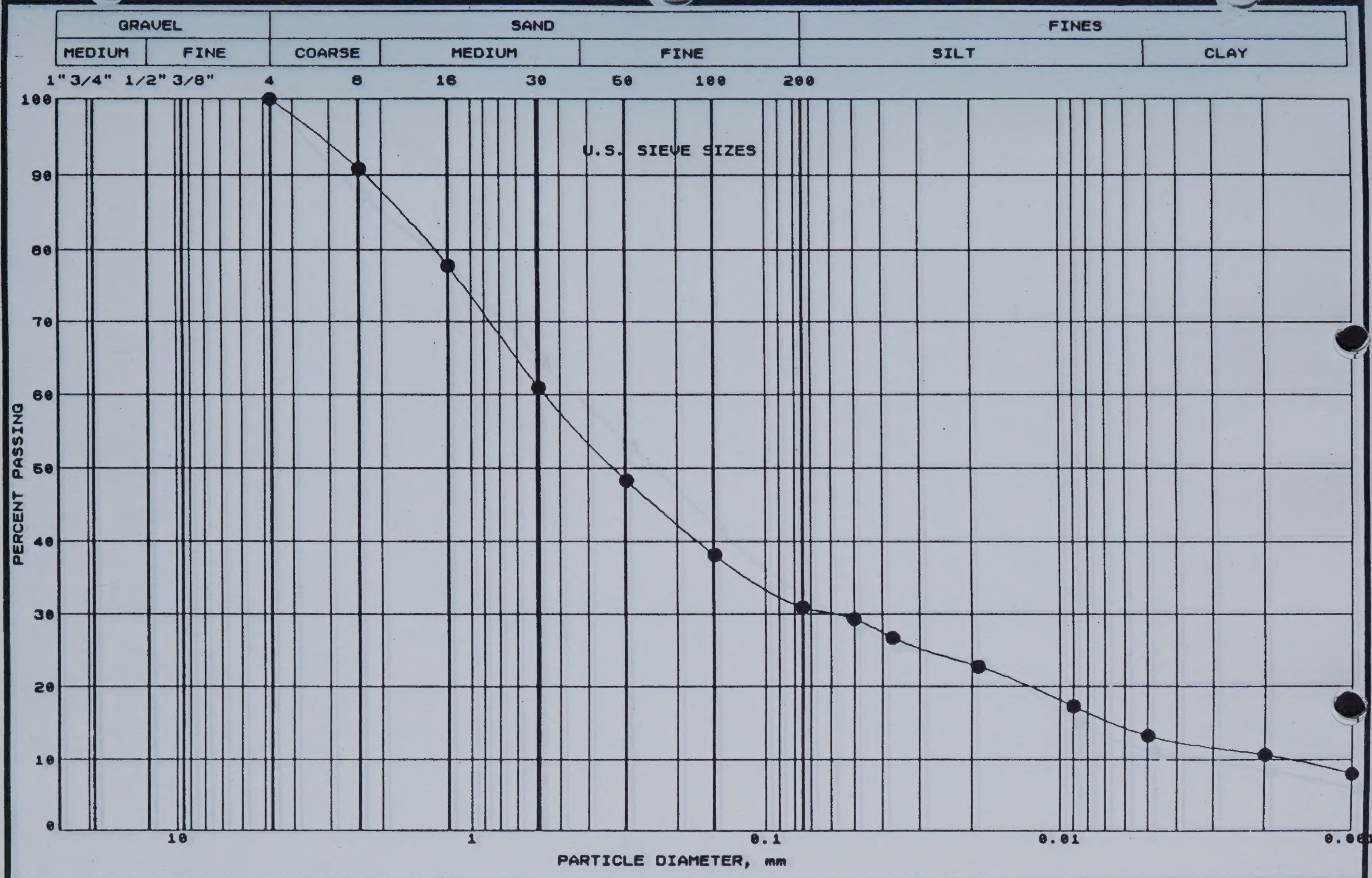
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Special Resource Management
Butte, MT.

NOTES:
Sample BL-L6 0.00

GRAVEL	0.0
SAND	75.9
SILT	13.4
CLAY	10.7

GRAIN SIZE ANALYSIS CURVE



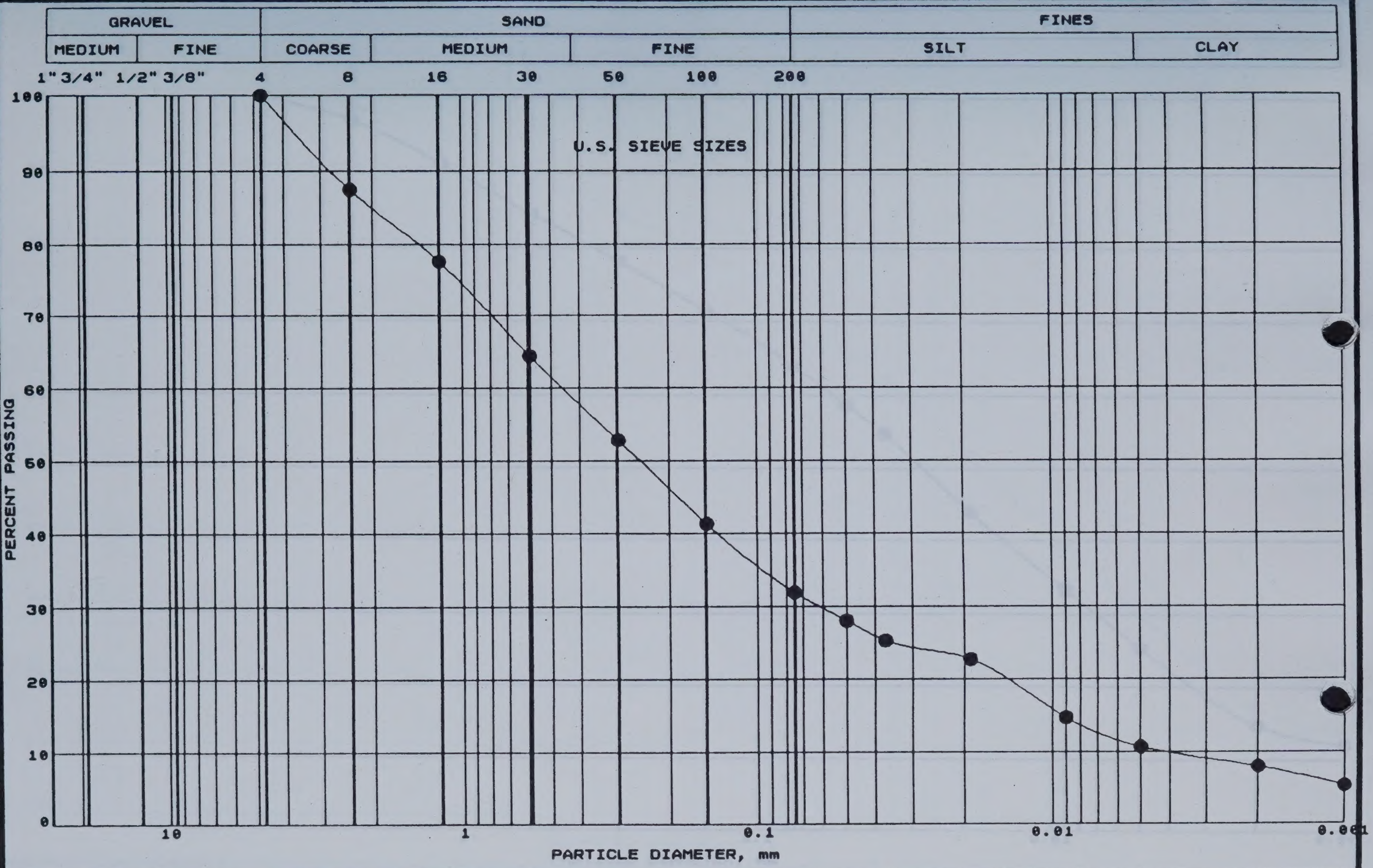
BRAUN
ENGINEERING TESTING

PROJECT: 890-164
Special Resource Management
Butte, MT.

NOTES:
Sample BL-L6 0.00

GRAVEL	0.0
SAND	69.1
SILT	17.6
CLAY	13.3

GRAIN SIZE ANALYSIS CURVE



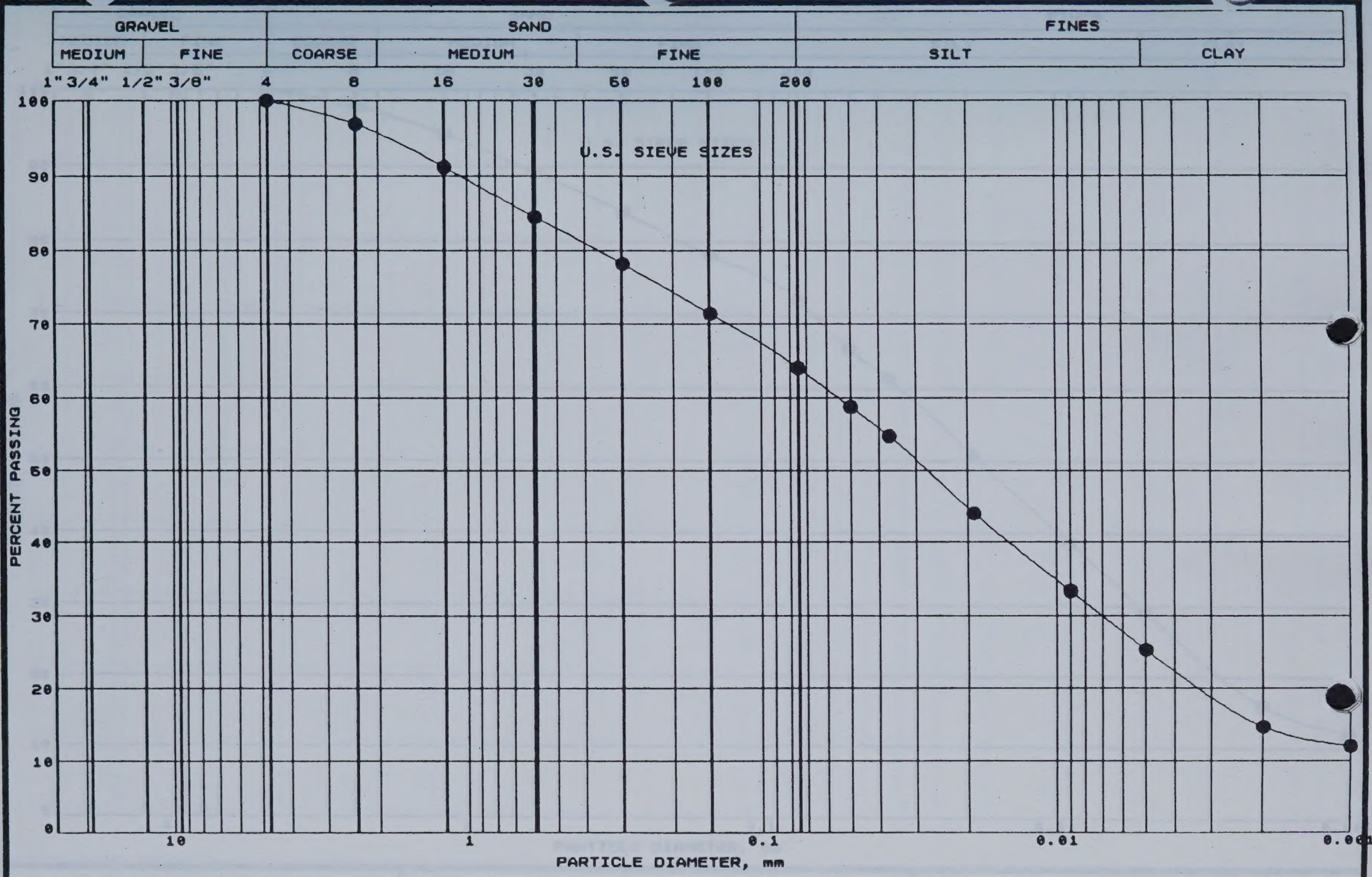
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Special Resource Management
Butte, MT.

NOTES:
Sample BL-L7 0.00

GRAVEL	0.0
SAND	68.1
SILT	21.2
CLAY	10.7

GRAIN SIZE A LYSIS CURVE



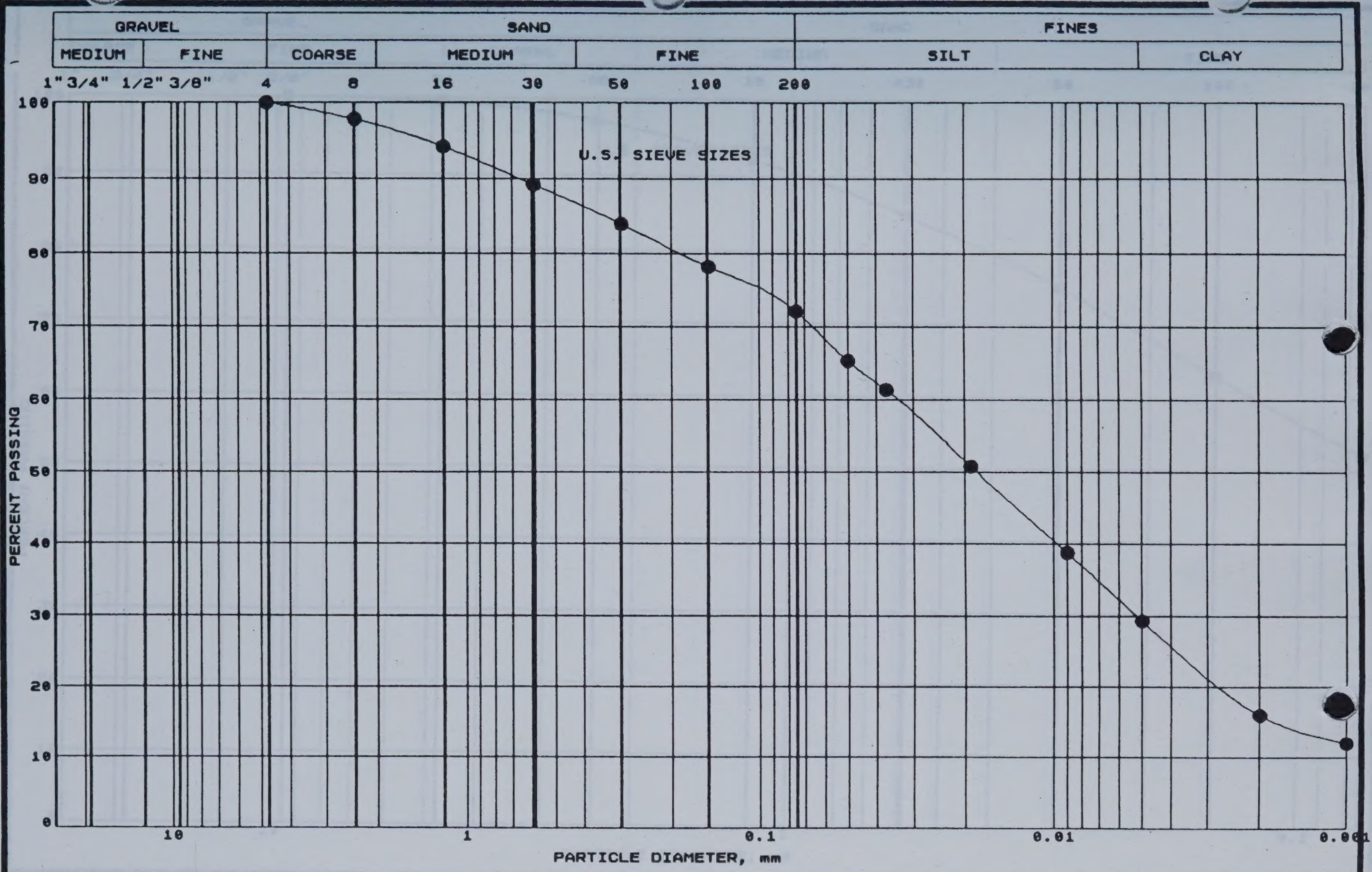
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Special Resource Management
Butte, MT.

NOTES:
Sample BL-L8 0.00

GRAVEL	0.0
SAND	36.0
SILT	38.7
CLAY	25.3

GRAIN SIZE ANALYSIS CURVE



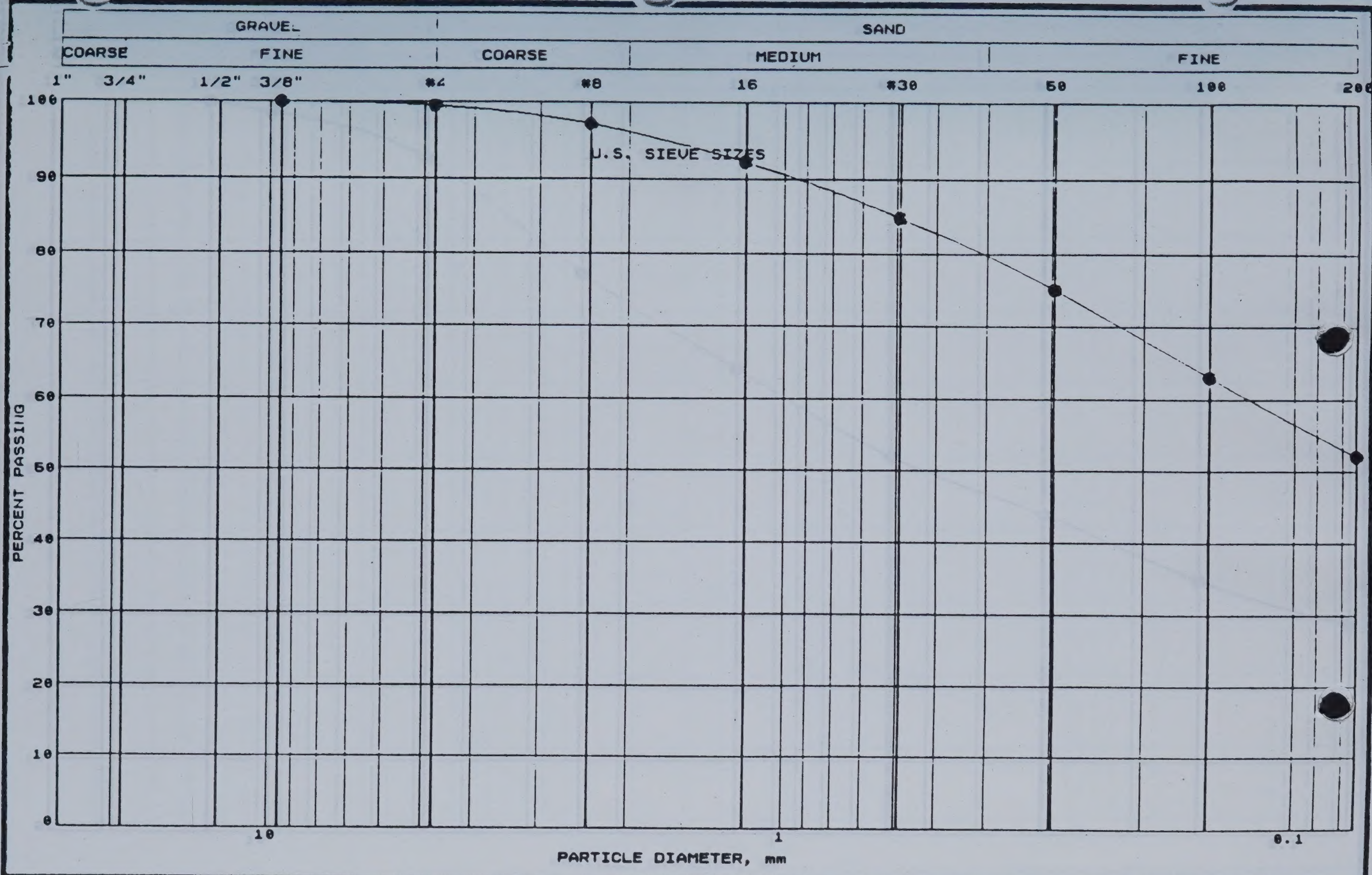
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Special Resource Management
Butte, MT.

NOTES:
Sample BL-L9 0.00

GRAVEL	0.0
SAND	28.0
SILT	42.7
CLAY	29.3

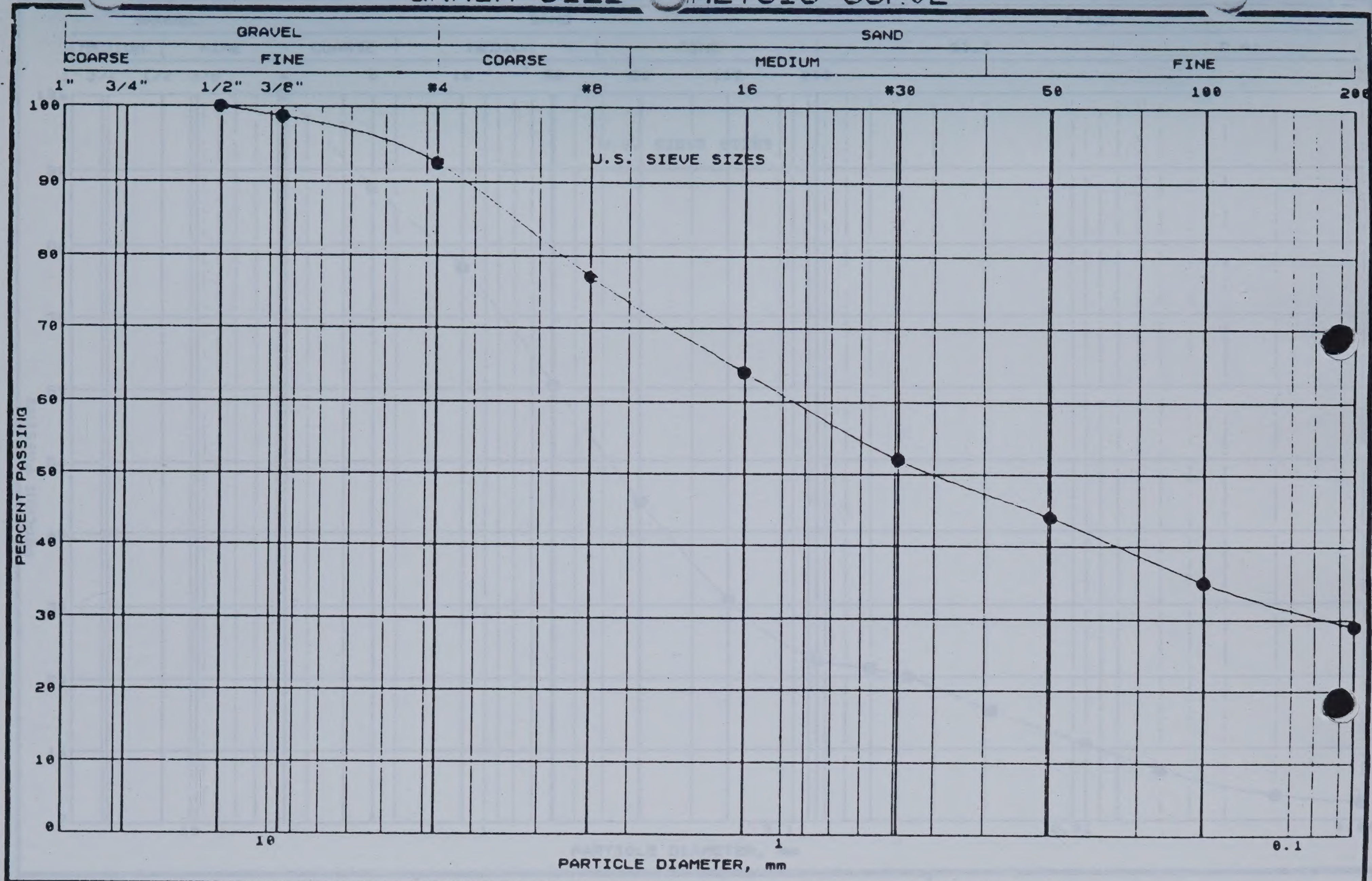
GRAIN SIZE ANALYSIS CURVE



BRAUN
ENGINEERING TESTING

PROJECT:	B90-164	GRAVEL	0.5
Laboratory Testing Butte, MT.		SAND	47.5
		Silt [illegible]	[illegible]
NOTES:			
Sample BL-A1	0.00		

GRAIN SIZE ALYSIS CURVE



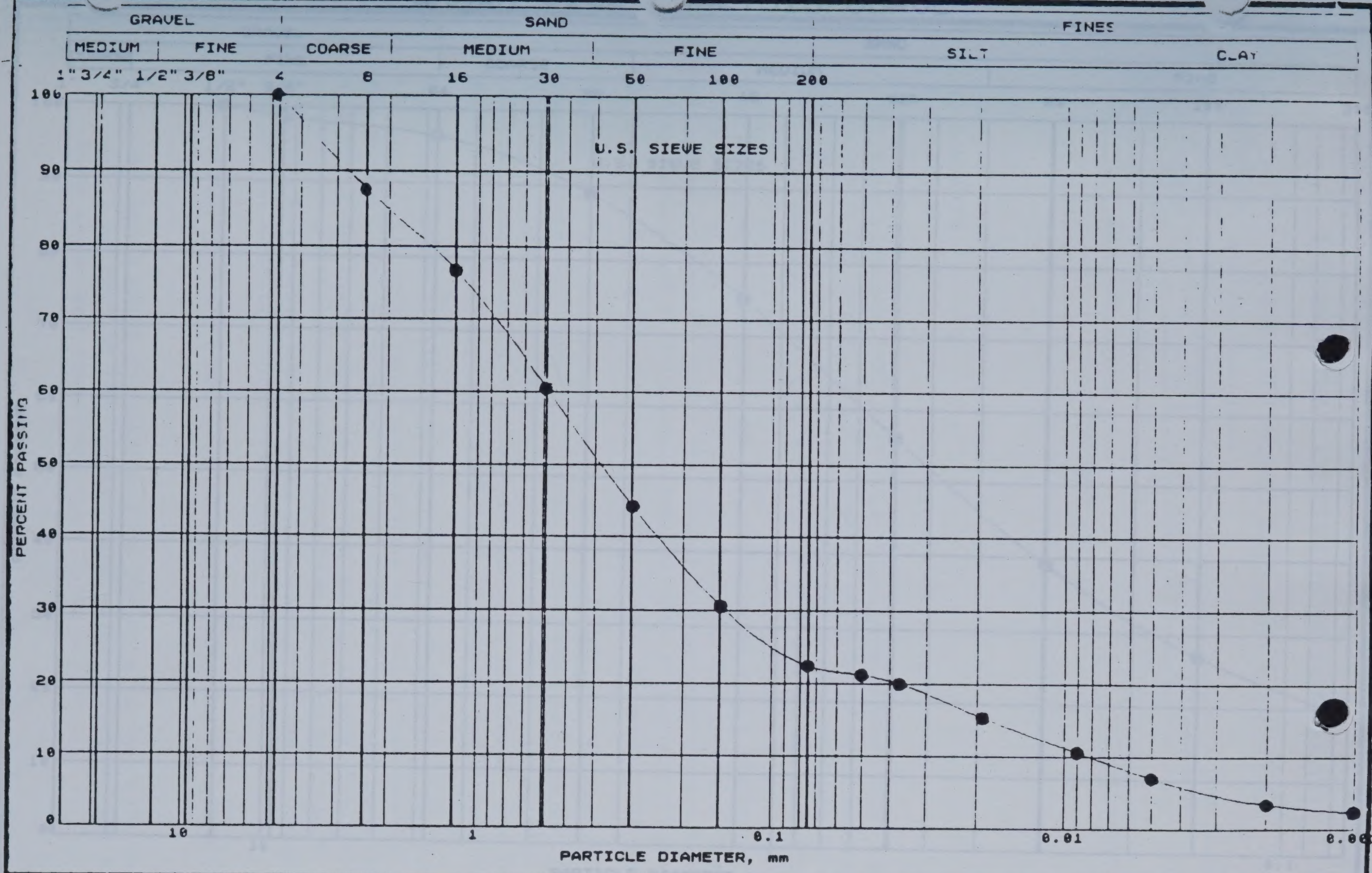
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Laboratory Testing
Butte, MT.

NOTES:
Sample BL-A1 6.00

GRAVEL	7.5
SAND	63.6
[illegible]	[illegible]

GRAIN SIZE ANALYSIS CURVE



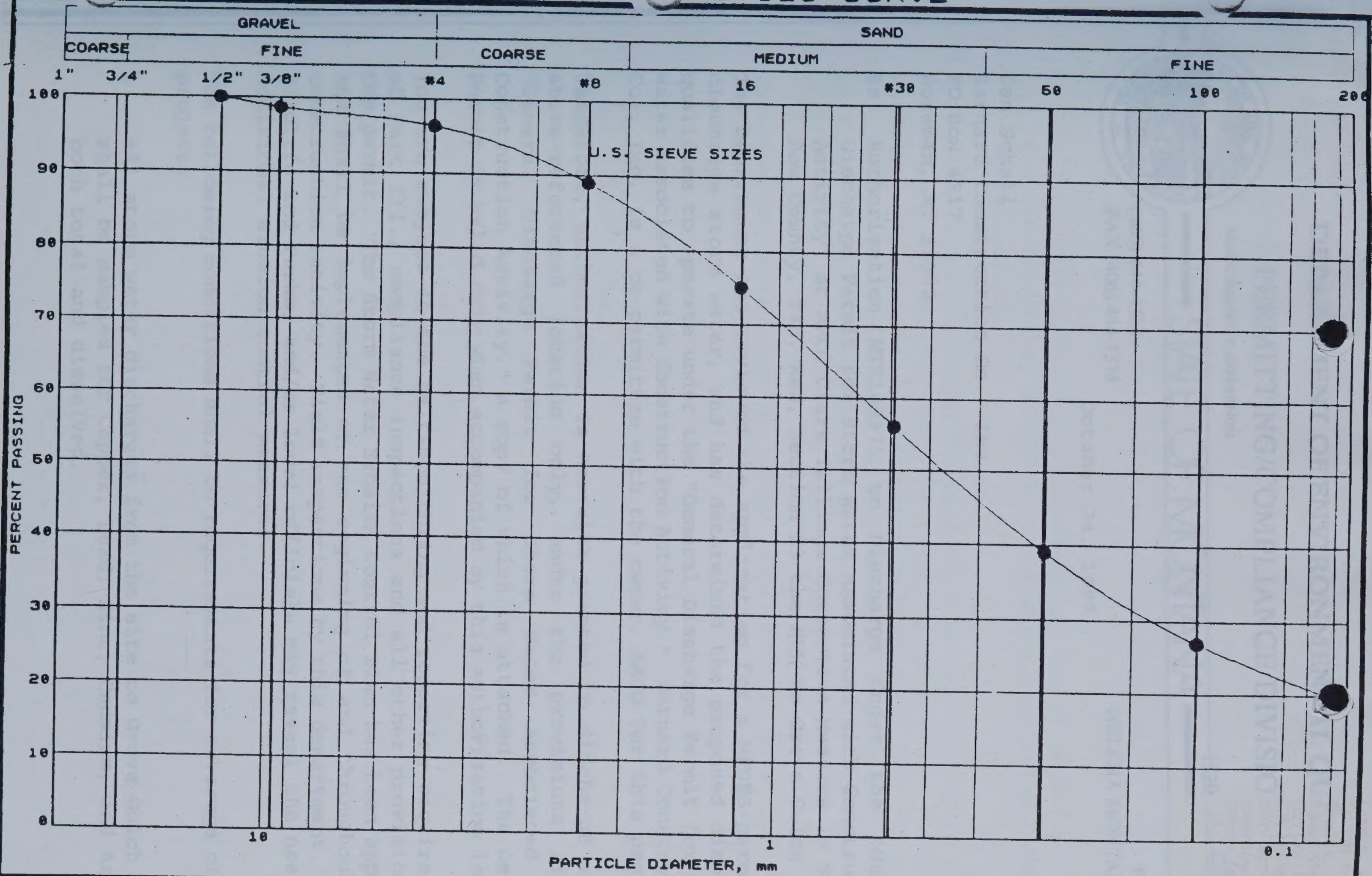
BRAUN
ENGINEERING TESTING

PROJECT: B90-164
Laboratory Testing
Butte, MT.

NOTES:
Sample BL-A2 5.00

GRAVEL	0.0
SAND	77.6
SILT	15.3
CLAY	7.1

GRAIN SIZE IALYSIS CURVE



BRAUN
ENGINEERING TESTING

PROJECT: B90-164

Laboratory Testing
Butte, MT.

NOTES:

Sample BL-A2 46.00

GRAVEL	3.6
SAND	77.4

Silt and clay [illegible]

Old Butte LF
Closure

DEPARTMENT OF ENVIRONMENTAL QUALITY

PERMITTING/COMPLIANCE DIVISION

MARC RACICOT, GOVERNOR

METCALF BUILDING
~~1520 EAST SIXTH AVENUE~~

STATE OF MONTANA

(406) 444-4323
FAX (406) 444-1374

PO BOX 200901
HELENA MONTANA 59620-0901

October 24, 1997

County Silver Bow
Facility & # Butte 20
Closure
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Other: Corrective Measures Assessment Closure
Landfarm
Liner
Methane
O & M
Run - On

Dan Schall
Barnard Construction Co., Inc.
PO Box 4917
Bozeman, MT 59702

Re: Authorization MTR100371 to Discharge Under the "General Discharge Permit for Storm Water Associated with Construction Activity" at ARCO Clark Tailings Corrective Measure in Silver Bow County, T3N, R8W, Section 23 the NE¼ to Grove Gulch Creek

The Department has reviewed the application for a MPDES permit to discharge storm water, and has determined the proposed discharge qualifies to operate under the "General Discharge Permit for Storm Water Associated with Construction Activity." Barnard Construction Co., Inc. is a co-permittee with the owner, ARCO for this project.

Therefore, authorization is herewith granted to discharge at the above-referenced location only, under the provisions of the "General Discharge Permit for Storm Water Associated with Construction Activity," a copy of which is attached. The General Permit is valid only when accompanied by this authorization letter.

You are subject to the self-monitoring and reporting requirements of Part III., compliance inspections and all other provisions of the permit. The Storm Water Erosion Control Plan has been approved and shall be implemented at the beginning of and throughout the construction activity. Field inspections by this department, Fish, Wildlife and Parks, and/or local officials may reveal the need for additional erosion control measures.

The following conditions shall be requirements for coverage of this project:

1. All storm water discharges from the site to Grove Gulch Creek shall be sampled for Copper, Lead, Zinc, Cadmium, and Arsenic both total and dissolved.

2. Absorbent materials of the appropriate type and in sufficient quantities shall be maintained on-site for initial response to spills.

3. All erosion control measures shall be installed according to the specifications stated in the Montana Sediment and Erosion Control Manual.

All storm water discharges related to coverage under this permit shall meet all numeric and narrative water quality standards, including non-degradation, for the receiving water body or bodies. A violation of, or non-compliance with, any provision of the permit is subject to enforcement action pursuant to the Montana Water Quality Act.

Issuance of authorization under this permit does not waive obligations to obtain other permits that may be required.

Roxann Lincoln

Roxann Lincoln CPSS
Water Quality Specialist
MPDES Storm Water Program
Permitting & Compliance Division

c: Pat Crowley, DEQ Community Service Bureau
Chuck Stillwell, ARCO
Mile High Conservation District

Old Butte closure —

PIONEER
TECHNICAL SERVICES, INC.

P.O. BOX 3445 BUTTE, MONTANA 59702
PHONE (406) 782-5177 FAX (406) 782-5866
e-mail pioneer@in-tch.com internet www.pioneer-technical.com

October 6, 1997

RECEIVED
OCT 0 9 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

F. Patrick Crowley
Manager, Solid Waste Program
Montana Department of Environmental Quality
1520 East Sixth Ave.
P.O. Box 200901
Helena, Montana 59620-0901

Dear Mr. Crowley:

Pursuant to my September 25, 1997 letter to you, and our subsequent phone conversation that afternoon, ARCO plans to treat the southern area of the Clark Tailings as surficial tailings in accordance with your verbal approval. In this area, mine wastes have been removed and the area will be backfilled to grade with clean fill. This area will not be capped with an infiltration barrier layer, since the waste has been removed.

As you and I discussed, the intent of the design was to field fit the extent of cap required; the cap perimeter shown on the construction drawings is an estimation of the required extent of cap. Where there are thin lifts of mine wastes near the perimeter of the cap, these wastes will be excavated and consolidated within the Clark Tailings fill in the same manner as surficial tailings. The extent of the cap will vary accordingly. Areas from which surficial tailings are removed will be backfilled with clean material as necessary and graded to prevent run-on to the waste management area.

If you have any questions or comments, please give me a call at 782-5177.

Sincerely,

Brad Archibald, P.E.

cc: James Johnston, BSB Public Works
Chris Sanchez, Anderson Engineering
Chuck Stilwell, ARCO

County Silver Bow
Facility & # Butte 20

Closure	Landfarm
Finan Assur	Liner
GW Corr Meas	Methane
GW Monitoring	O & M
GW Reports	Run - On
Inspections	

Other: Corrective Measures
Assessment Closure
4-3

Butte old l.F.
Closure/CMA

PIONEER
TECHNICAL SERVICES, INC.

P.O. BOX 3445 BUTTE, MONTANA 59702
PHONE (406) 782-5177 FAX (406) 782-5866
e-mail pioneer@in-tch.com internet www.pioneer-technical.com

September 25, 1997

RECEIVED
SEP 26 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

F. Patrick Crowley
Manager, Solid Waste Program
Montana Department of Environmental Quality
1520 East Sixth Ave.
P.O. Box 200901
Helena, Montana 59620-0901

Dear Mr. Crowley:

During excavation of tailings at the southern end of the Clark Tailings, to the grades shown on the approved construction drawings, we have apparently excavated through the mine waste into native materials. The area in question, shown on the attached site sketch, covers approximately two acres. This area was delineated on September 18, 1997. ARCO requests approval to cover this area with clean fill and growth media over the clean subgrade materials.

Within this area, there are some minor spots that appear to have mine waste present at and near the surface. ARCO plans to direct it's contractor, Barnard Construction Company, Inc., to remove all of these materials, with either a dozer or grader, and place them to the north with other waste materials. ARCO then plans to backfill this area to grade with Type C (clean fill) materials, overlaid by six inches of Type G (growth media) material. ARCO does not plan to install the approved low permeability cap over this area, as shown on the drawings, since the mine waste will have been removed. This is the same procedure used for the surficial tailings area on the north side of the Clark Tailings, identified in the design drawings. In essence, ARCO plans to treat this two-acre area in the same manner as the surficial tailings.

If you have any questions or concerns regarding this matter, please give me a call at your earliest convenience. ARCO plans on directing Barnard to complete the removal in this area yet this week.

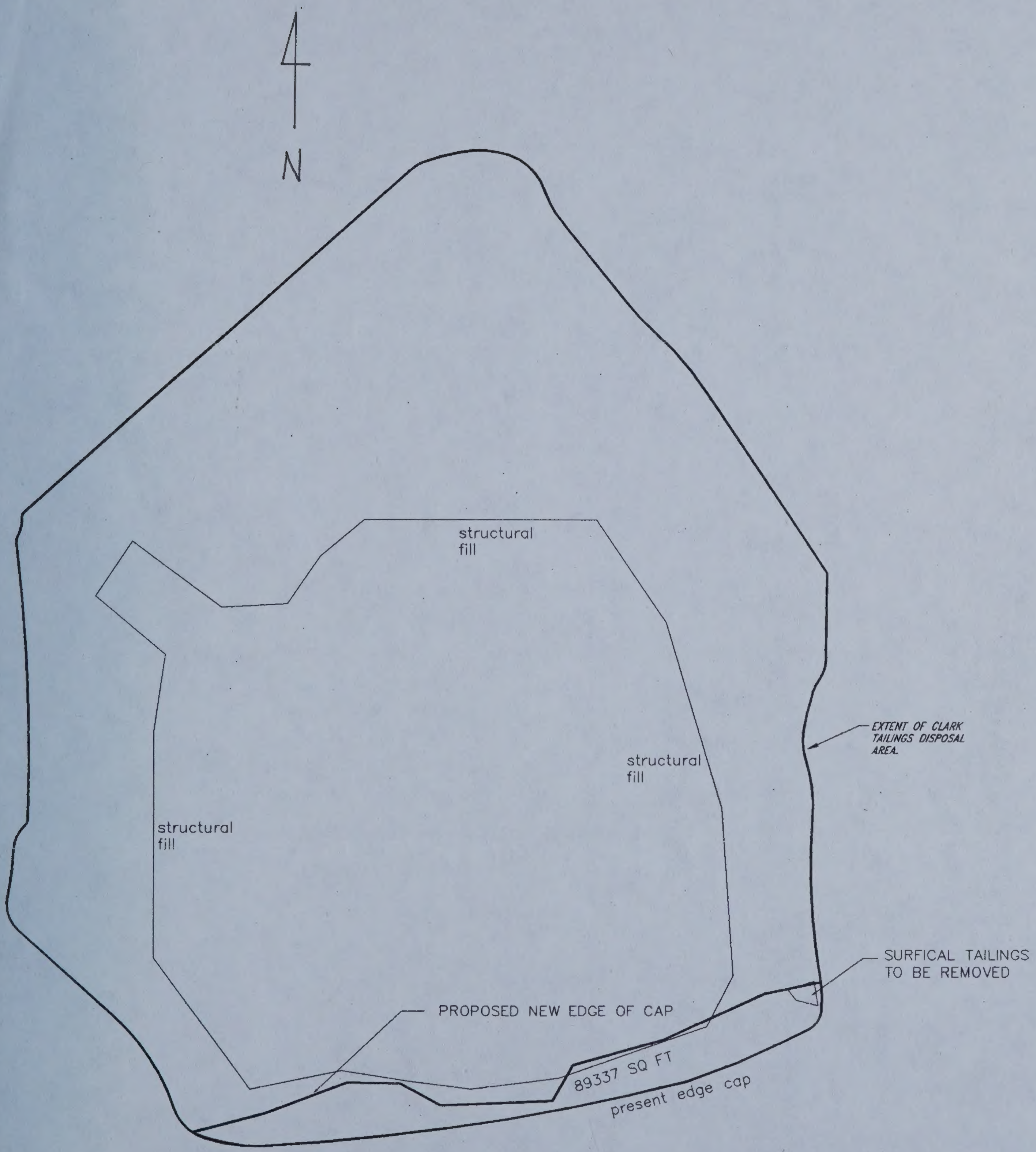
Sincerely,

Brad Archibald

Brad Archibald, P.E.

cc: James Johnston, BSB Public Works
Chris Sanchez, Anderson Engineering
Chuck Stilwell, ARCO

County Silver Bow
Facility & # Butte 20
Closure
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Landfarm
Liner
Methane
O & M
Run - On
Other: Corrective Measures Assessment Closure
4-3


N
structural fill
structural fill
structural fill
EXTENT OF CLARK TAILINGS DISPOSAL AREA.
SURFICAL TAILINGS TO BE REMOVED
PROPOSED NEW EDGE OF CAP
89337 SQ FT
present edge cap

PIONEER
TECHNICAL SERVICES, INC.

P.O. BOX 3445 BUTTE, MONTANA 59702
PHONE (406) 782-5177 FAX (406) 782-5866
e-mail pioneer@in-tch.com internet www.pioneer-technical.com

Post-it™ brand fax transmittal memo 7671

# of pages ▸ 2	
To PAT CROWLEY	From BRAD A
Co.	Co.
Dept.	Phone # 782-5177
Fax # 444-1374	Fax #

September 25, 1997

F. Patrick Crowley
Manager, Solid Waste Program
Montana Department of Environmental Qualit
1520 East Sixth Ave.
P.O. Box 200901
Helena, Montana 59620-0901

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Post-it™ brand fax transmittal memo 7671

# of pages ▸	
To Chris Sanchez	From BRAD
Co. ANDERSON	Co.
Dept.	Phone #
Fax # 723-1141	Fax #

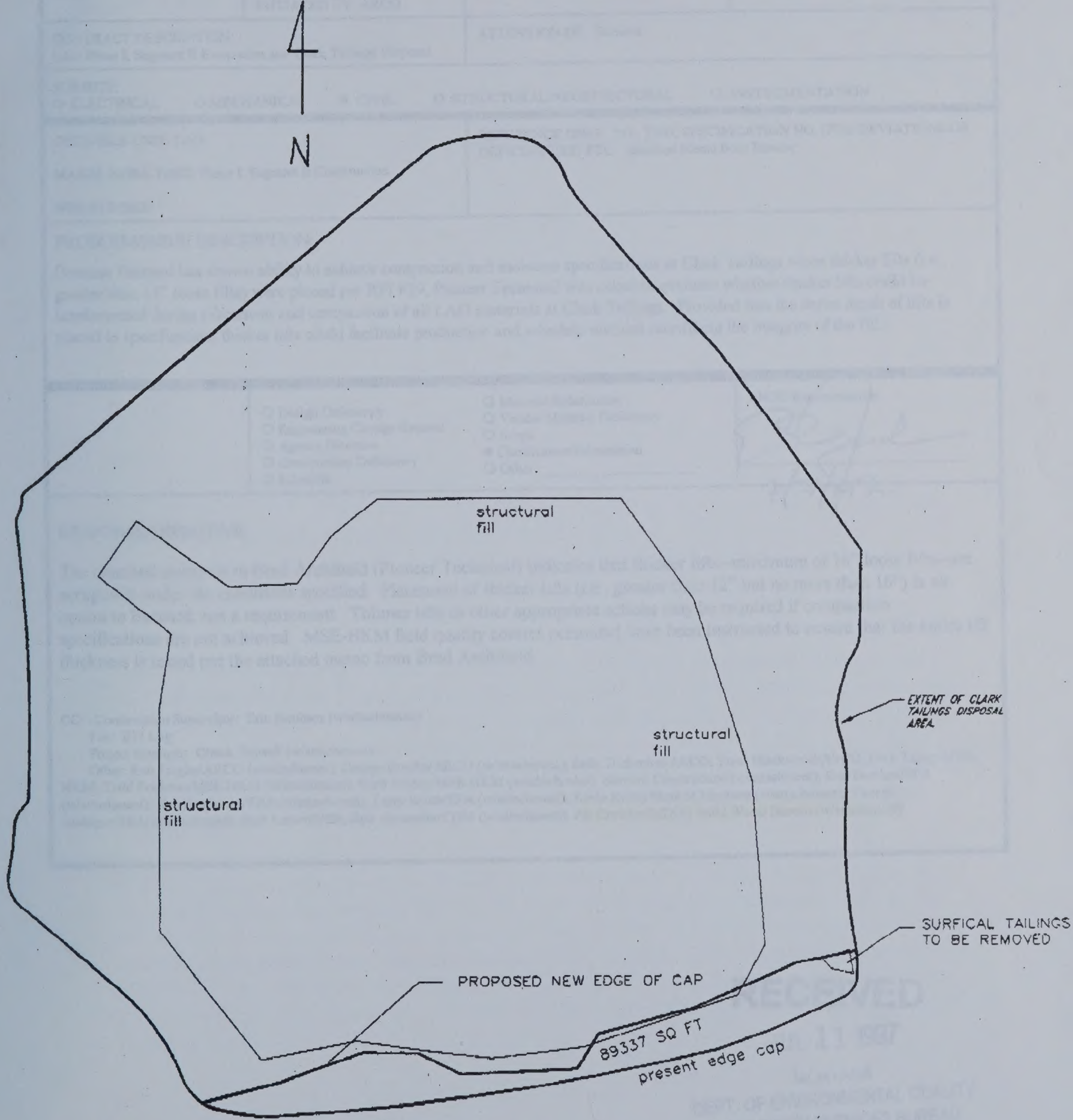
Sincerely,

Brad Archibald

Brad Archibald, P.E.

cc: James Johnston, BSB Public Works
Chris Sanchez, Anderson Engineering
Chuck Stilwell, ARCO

100% post consumer paper & 100% vegetable based inks


N
structural fill
structural fill
structural fill
EXTENT OF CLARK TAILINGS DISPOSAL AREA
SURFICAL TAILINGS TO BE REMOVED
PROPOSED NEW EDGE OF CAP
89337 SQ FT
present edge cap

Corporate Environmental Remediation
ARCO

RFI - REQUEST FOR INFORMATION

DATE 7/7/97	RFI NO. 38 INITIATED BY: ARCO	CONTRACTOR Barnard Construction	CONTRACT NO. M96532

CONTRACT DESCRIPTION: LAO Phase I, Segment II Excavation and Clark Tailings Disposal	ATTENTION OF: Barnard

SUBJECT:
○ ELECTRICAL ○ MECHANICAL ● CIVIL ○ STRUCTURAL/ARCHITECTURAL ○ INSTRUMENTATION

OPERABLE UNIT: LAO MAJOR WORK TASK: Phase I, Segment II Construction WBS NUMBER:	REFERENCE DWG., P.O., TAG, SPECIFICATION NO. (FOR DEVIATIONS OR DEFICIENCIES) ETC: Attached Memo from Pioneer

PROBLEM/ISSUE DESCRIPTION:

Because Barnard has shown ability to achieve compaction and moisture specifications at Clark Tailings when thicker lifts (i.e., greater than 12" loose lifts) were placed per RFI #29, Pioneer Technical was asked to evaluate whether thicker lifts could be implemented during placement and compaction of all LAO materials at Clark Tailings. Provided that the entire depth of lifts is placed to specification, thicker lifts could facilitate production and schedule without sacrificing the integrity of the fill.

	○ Design Deficiency ○ Engineering Change Request ○ Agency Directive ○ Construction Deficiency ○ Schedule	○ Material Substitution ○ Vendor Material Deficiency ○ Scope ● Clarification/Information ○ Other ______________	ARCO Representative: 7/7/97.

RESPONSE/DIRECTIVE:

The attached memo from Brad Archibald (Pioneer Technical) indicates that thicker lifts--maximum of 16" loose lifts--are acceptable under the conditions specified. Placement of thicker lifts (i.e., greater than 12" but no more than 16") is an option to Barnard, not a requirement. Thinner lifts or other appropriate actions may be required if compaction specifications are not achieved. MSE-HKM field quality control personnel have been instructed to ensure that the entire lift thickness is tested per the attached memo from Brad Archibald.

CC: : Construction Supervisor: Eric Jacobsen (w/attachments)
File: RFI Log
Project Manager: Chuck Stilwell (w/attachment)
Other: Ron Ziegler/ARCO (w/attachment); George Brooks/ARCO (w/attachment); Sally Dickerson/ARCO; Traci Blackwood/ARCO; Dick Talley/MSE-HKM; Todd Erickson/MSE-HKM (w/attachment); Scott Hurley/MSE-HKM (w/attachment); Barnard Construction (w/attachment); Ron Bertram/EPA (w/attachment); Ken Brockman/EPA (w/attachment); Larry Smith/EPA (w/attachment); Kevin Kirley/State of Montana (w/attachment); George Austiguy/ESA(w/attachment); Rick Larson/BSB; Bob Alexander/CDM (w/attachment); Pat Crowley/MDEQ Solid Waste Bureau (w/attachment)

RECEIVED
JUL 11 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

PIONEER
TECHNICAL SERVICES, INC.

P.O. BOX 3445 BUTTE, MONTANA 59702
PHONE (406) 782-5177 FAX (406) 782-5866
e-mail pioneer@in-tch.com internet www.pioneer-technical.com

DE #38

MEMORANDUM

CONFIDENTIAL
PRIVILEGED ATTORNEY-CLIENT COMMUNICATION
ATTORNEY WORK PRODUCT
PREPARED IN ANTICIPATION OF LITIGATION

DATE: July 3, 1997

TO: Eric Jacobsen, ARCO
Chuck Stilwell, ARCO

FROM: Brad Archibald, P.E. BOA

RE: Lift Thickness at Clark Tailings

You have asked Pioneer to consider allowing thicker lifts during placement and compaction of the LAO materials at the Clark Tailings. The current specification requires lifts no greater than 12-inches loose thickness. Pioneer previously approved thicker lifts for the first lifts until soft subgrade areas are bridged (see Archibald 4/18/97 memo to Jacobsen). Testing conducted to date on these thicker lifts shows that Barnard has been able to meet the compaction and moisture specifications with these thicker lifts (per verbal communication with you and Scott Hurley, MSE-HKM).

Thicker lifts, up to 16-inches loose thickness, are allowable provided that Barnard continues to consistently achieve the moisture and density requirements and all other specifications for the placement and compaction of Type I materials. Furthermore, as I stated in my 4/18 memo, the construction inspector must ensure that the full lift thickness is being tested for moisture content and density. Be aware that at some point the thicker lifts will actually slow production rather than increasing it. The extra compactive effort required will offset the extra volume of material placed in the lift.

DEPARTMENT OF ENVIRONMENTAL QUALITY
PERMITTING & COMPLIANCE DIVISION
STORM WATER PROGRAM
MARC RACICOT, GOVERNOR
Metcalf Building
STATE OF MONTANA
Phone: (406)444-4323
Fax: (406)444-1374
PO Box 200901
Helena, MT 59620-0901I

June 24, 1997

Chuck Stillwell
Clark Tailings Project Manager
ARCO
307 East Park Street
Anaconda, MT 59711

Dan S. Schall
Barnard Construction
P.O. Box 99
Bozeman, MT 59771-0099

Dear Sirs:

It has come to the attention of the department that discharges from the construction project covered under permit # MTR 100371 at the Clark Tailings in Butte, MT may potentially contain metals in the discharge waters. According to Part IV, Section Q, Reopener Provision, (page 17) of your General Discharge Permit for Storm Water Associated with Construction Activity, the Department has the authority to modify the permit to include different limitations and/or requirements if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the construction activity.

Because of the material involved in the construction activity, Barnard Construction is hereby required to sample all future storm water discharges from the site to Grove Gulch Creek for the following:

Copper, Total and Dissolved
Lead, Total and Dissolved
Zinc, Total and Dissolved
Cadmium, Total and Dissolved
Arsenic, Total and Dissolved

The point of sampling may either be at the sedimentation pond down drop inlet or at the point where Grove Creek emerges from beneath the tailings dam. In the event that the latter point is chosen, you may wish to sample the creek prior to its entrance to the diversion pipe in order to determine background values of the receiving water.

"AN EQUAL OPPORTUNITY EMPLOYER"

The Department will have a representative, Mr. Patrick Crowley, at the site on Wednesday, June 25, 1997, to inspect the project. If you have any questions on this matter, please feel free to ask Pat, or call me at 444-5329, or Roxann Lincoln at 444-5338.

Sincerely.

Fred Shewman

Fred Shewman
Section Supervisor

Storm Water GDP
Permit No.: MTR100000

MTR100371

GENERAL DISCHARGE PERMIT FOR

STORM WATER ASSOCIATED WITH CONSTRUCTION ACTIVITY

MONTANA DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

AUTHORIZATION TO DISCHARGE UNDER THE

MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with Section 75-5-101 *et seq.*, MCA, ARM 16.20.1301 *et seq.*, and ARM 16.20.601 *et seq.*, applicants with an authorization letter for this "Storm Water Associated with Construction Activity General Discharge Permit," are permitted to discharge storm water resulting only from construction activities, to state waters in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, III and IV hereof.

This permit shall become effective on the date of issuance.

This permit shall expire at midnight, August 31, 1997.

FOR THE MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES

Frederick C. Shewman

Frederick C. Shewman, P. E., Supervisor
Permits/Groundwater Section
Water Quality Bureau
Environmental Sciences Division

Dated this 17th day of November, 1992

PREAMBLE

The purpose of this preamble is to provide the permit holder with some understanding of what is required for compliance under this permit.

The basic principle of the permit is to identify areas or activities which may contribute pollutants to surface waters and consider practical methods to reduce such pollutants from your operation. The degree of pollution control needed will vary depending on the site and the situation. For example, if you are constructing a road on perfectly flat ground in which there are no surface waters in close proximity to your activities, the potential to cause pollution of surface water is minimal and only minimal erosion controls would be expected. On the other hand, if you are constructing a highway and there are several stream drainages, wetlands, etc. in close proximity to your project, very comprehensive and complete pollution controls would be expected.

The major pollutant that will be a problem for construction sites will be sediment discharges from increased erosion. If the project will impact a "live" water body (a stream , lake, reservoir, etc. that has water year round), you **must** insure that sediment does not reach state waters by using appropriate erosion control practices. The discharge of discolored water could cause a violation of this permit. Adequate erosion control practices must also be used to prevent sediment discharges to wetlands, riparian areas, and ephemeral drainages.

Other pollutants most likely to be a problem at construction sites are fuels, lubricating oils, construction materials, fertilizers and pesticides. The bottom line is store these materials properly and well away from surface waters, to prevent spills of these materials, and by not dumping in the first place.

The basic requirements of the "Storm Water Erosion Control Plan" are provided in Part II.

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- B. Sources Covered Under This Permit
- C. Application Procedures

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- C. Storm Water Erosion Control Plan

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- B. Recording Requirements
- C. Reporting Requirements
- D. Records Retention
- E. Noncompliance Reporting
- F. Penalties for Tampering

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- B. Continuation of the Expired Permit
- C. Need to Halt or Reduce Activity not a Defense
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- L. Severability
- M. State Laws
- N. Proper Operation and Maintenance
- O. Inspection and Entry
- P. Permit Actions
- Q. Reopener Provision
- R. Notice of Termination
- S. Definitions

I. COVERAGE UNDER THIS PERMIT

A. Permit Area

The permit applies to all areas of the state of Montana except Indian Reservations.

B. Sources Covered Under This Permit

The permit covers construction activities including clearing, grading, or excavating which will result in the disturbance of a total of five (5) or more acres or greater than one acre of contiguous disturbed contributing drainage area, any part of which is located within one hundred (100) feet of state waters (waterway). All discharges shall be in accordance with the "approved" erosion control plan and the provisions of this permit.

Any other direct waste discharge to public waters is prohibited unless covered by another MPDES permit.

This permit does not relieve the permittee from responsibility for compliance with any other applicable federal, state, or local law, rule, standard, ordinance, order, judgement, or decree.

C. Application Procedures

1. **Application Due Dates:** At least thirty (30) days prior to construction taking place, or by October 1, 1992, whichever is later, the permittee (see definitions) of the construction activity shall submit an application as provided by the Department.

2. **Application Form:** The application form requires, at a minimum, the following information:

   1) Name and address of contractor;
   2) Construction site address and name of owner/operator (for MDT projects, project number and designation);
   3) Contact person and telephone number;
   4) The nature of the construction activity;
   5) Total area of the site and the area that will be disturbed;
   6) Site location (County, Township, Range,

Section, 1/4 Section);

7) The best management practices to be used during construction to control sediment and erosion.

8) The best management practices to be used to control pollutants in storm water after construction is completed;

9) Name of receiving water and indicate if discharging to a municipally owned storm sewer;

10) A detailed erosion control plan must be approved prior to construction taking place;

11) A site map and a drainage map (with drainage patterns indicated).

3. **Application Submittal:** A signed state application form shall be submitted to:

Montana Department of Health and Environmental Sciences
Water Quality Bureau, Room A206
1400 Broadway
PO Box 200901
Helena, MT 59620-0901

4. **Authorization to Discharge:** Construction activities covered under this permit are authorized to begin construction and implement the "approved" erosion control plan in accordance with the permit upon receipt of an authorization under the general permit issued by the Department.

PART II.

II. SPECIAL CONDITIONS

A. Prohibitions on Non-storm Water Discharges

All discharges covered by this permit shall be composed entirely of storm water. Discharges of material other than storm water runoff must be in compliance with an MPDES permit (other than this permit) issued for the discharge.

B. Releases in Excess of Reportable Quantities

The discharge of hazardous substances or oil in the storm water discharge(s) from construction activities shall be minimized in accordance with the applicable

Erosion Control Plan for the project. Where a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR 110, 40 CFR 117 or 40 CFR 302, occurs during a 24 hour period:

(1) The person in charge of the construction project is required to notify the Nation Response Center (800-424-8802) and the Water Quality Bureau (444-5338) as soon as he or she has knowledge of the discharge;

(2) The permittee shall submit, within 7 calendar days of knowledge of the release, a report with a description of the release (including the type and estimate of the amount of material released), the circumstances leading to the release, and steps to be taken to remediate environmental contamination associated with the release to the Montana Department of Health and Environmental Sciences at the address provided in Part III.C.; and

(3) The Storm Water Erosion Control Plan described below must be modified within 7 calendar days of knowledge of the release to: provide a description of the release and the circumstances leading to the release; and to identify and provide for the implementation of steps to prevent the reoccurrence of such releases and to respond to remediation of such releases.

C. Storm Water Erosion Control Plan

Prior to commencement of construction or by October 1, 1992, whichever occurs later, the permittee shall prepare and implement an **Erosion Control Plan.** The objective of the plan is to minimize the erosion of disturbed land during the construction and post construction activities and to minimize pollutants such as fuels, oil, grease, fertilizer, pesticides, concrete truck washout, etc. from discharging to surface waters.

The plan shall:

(a) be submitted to the Department 30 days prior to construction or by October 1, 1992, whichever occurs later, for approval;

(b) be signed in accordance with the signatory requirement in Part IV.G.;

(c) a copy shall also be maintained at the construction site in accordance with part III.D. of this permit; and

(d) provide for compliance with the terms and schedule of the plan once approved by the Department and updated as appropriate.

1. a) The contractor of a construction project covered by this permit shall maintain a copy of the erosion control plan on-site and a copy of the plan shall be available upon request to the owner, the Montana Department of Fish, Wildlife and Parks, local officials, and a municipal operator if the discharge is through a municipal system.

   b) The plan must be approved by the Department and implemented at the beginning and throughout the lifespan of the project. The Department may notify the permittee at any time that the plan does not meet one or more of the minimum requirements of this part. After such notification from the Department, the permittee shall make changes to the plan and submit a written certification that the requested changes have been made to the Department. Unless otherwise provided by the Department, the permittee shall have 7 days after such notification to make the required changes.

   c) The permittee shall amend the plan whenever there is a change in design, construction, operation, or maintenance, which has a significant effect on the potential for the discharge of pollutants to waters of the state or if the erosion control plan proves to be ineffective in achieving the general objectives of controlling pollutants in storm water discharges associated with construction activity.

2. The plan may include the use of sediment basins, berms, barriers, filter strips, covers, diversion structures, seeding, sodding, and/or other control structures or best management practices (BMPs). Any plan which requires engineered structures, such as detention ponds or diversion structures, or which is prepared for a construction activity

which includes 20 acres or more in total land disturbance, shall be prepared by a registered professional engineer. The erosion control plan shall include at least the following items:

a. Site Description. Each plan shall, at a minimum, provide a description of the following:

(1) The nature of the construction activity, including a proposed timetable for major activities;

(2) Estimates of the total area of the site, and all other sites if a phased development project, and the area of the site that is expected to undergo clearing, excavation, and/or grading;

(3) A site map indicating areas of total development and, as a minimum, all areas of soil disturbance, areas of cut and fill, drainage patterns and approximate slopes anticipated after major grading activities, areas used for the storage of soils or wastes, location of all erosion control facilities or structures and areas where vegetative practices are to be implemented, the location of impervious structures (including buildings, roads, parking lots, outdoor storage areas, and etc.) after construction is completed, springs, wetlands and other surface waters, and the boundary of 100-year flood plains, if determined;

(4) The nature of fill material to be used, the existing soils located at the site, and the erodibility of such soils: and

(5) The names of the receiving water(s) and the size, type and location of each outfall or, if the discharge is to a municipal separate storm sewer, a letter of approval from the municipality which authorizes use of the storm sewer and the location of any storm sewer discharge to public waters.

b. Controls

Each operator covered by this permit shall develop, as part of the erosion control plan, a description of controls appropriate for the site and shall implement such controls. The following minimum
components shall be addressed along with a

schedule for implementation, unless approved otherwise in writing by the permit issuing agency:

(1) A description, including a schedule of implementation, of stabilization practices designed to preserve existing vegetation where practicable and re-vegetate open areas as soon as practicable after grading or construction. In developing vegetative practices, the operator shall consider: temporary seeding, permanent seeding, mulching, sod stabilization, vegetative buffer/filter strips, grassed waterways, erosion control blankets and tree and shrub planting.

(2) A description of structural practices which indicates how, to the degree practicable, the permittee will divert flows from exposed soil, store flows, or otherwise limit runoff from exposed areas of the site. In developing structural practices, the operator shall consider the appropriateness of: straw bale dikes, silt fences, earth dikes, brush barriers, drainage swales, check dams, subsurface drains, pipe slope drains, rock outlet protection, drain inlet and outlet protection, temporary drain diversions, sedimenttraps, temporary sediment basins, infiltration trenches or basins, and retaining walls. None of the temporary control structures, including silt fences and straw bale dikes, shall be removed until permanent vegetation and site stabilization has taken place.

(3) For sites in which the tracking of sediment onto public or private roads during the wet season (November - June) will be a problem, the site shall have graveled access entrance and exit drives and parking areas. All unpaved roads on the site carrying more than 25 vehicle trips per day shall be graveled.

(4) When trucking saturated soils from the site, either tight trucks shall be used or loads shall be required to drain until drippage has been reduced to less than 1 gallon per hour before leaving the site.

3. Visible or measurable erosion which leaves the construction site is prohibited. Visible or measurable

erosion is defined as:

a. Deposits of mud, dirt, sediment or similar material exceeding 1/2 cubic foot in volume in any area of 100 square feet or less on public or private streets, adjacent property, or into the storm and surface water system, either by direct deposit, dropping, discharge, or as a result of the action of erosion; or

b. Evidence of concentrated flows of water over bare soils; turbid or sediment laden flows; or evidence of on-site erosion such as rivulets on bare soil slopes, where the flow of water is not filtered or captured on the site using the techniques in the approved erosion control plan; or

c. Earth slides, mud flows, earth sloughing, or other earth movement which leaves the construction site.

4. If any visible or measurable quantities of sediment leave the site because of the failure of the erosion control facilities, the sediment shall be immediately (within 24 hours) cleaned up and placed back on the site or disposed of in a manner approved by the Department. Under no conditions shall the sediment be washed into the storm sewers or drainageways.

5. All non-regulated wastes composed of building material must be removed from the site or disposed in approved disposal facility. Building material wastes or unused materials may not be dumped or discharged at the site. The State Solid Waste Program should be contacted concerning proper disposal of waste materials.

6. A description of measures to control pollutants in storm water discharges that will occur after construction operations have been completed shall be addressed in the erosion control plan. Such practices may include: storm water detention structures (including wet ponds); storm water retention structures; flow attenuation by use of open vegetated swales and natural depressions; and infiltration of runoff on site.

PART III.

III. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Monitoring Requirements

During the period beginning immediately and lasting through the duration of the permit, the permittee is authorized to discharge from outfall(s) as required within the erosion control plan. Such discharges shall be limited and monitored by the permittee as specified below:

1. All erosion control facilities shall be inspected by or under the direction of the permittee at least once every seven calendar days and within 24 hours after any storm event of greater than 0.5 inches of rain per 24 hour period.
2. During stormy periods or periods of snow melt when runoff occurs daily, all erosion control facilities shall be inspected by or under the direction of the permittee daily.
3. Storm water runoff discharges shall be visually monitored at the above frequency to evaluate the effectiveness of the pollution control facilities or practices. If any measurable quantities of sediment are leaving the property, corrective action shall be taken within 24 hours to reduce the discharge of sediments.

B. Recording Requirements

The operator shall keep a record of inspections, the date and time inspected, and the name of the person performing the inspection. Uncontrolled releases of mud or muddy water or measurable quantities of sediment found off the site shall be recorded with a brief explanation as to the measures taken to prevent future releases as well as any measures taken to clean up the sediment that has left the site. This record shall be made available to the Department upon request and shall be signed in accordance with the signatory and certification requirements of Parts IV.G. and IV.H.

C. Reporting Requirements

If the construction activity lasts more than 12 months, an annual inspection of the site shall be conducted to identify areas which may be contributing pollutants to storm water discharges. The annual inspection report shall be submitted to the Department 30 days after the inspection has taken place. Inspection results shall be reported in writing to the Department address below:

Montana Department of Health and Environmental Sciences
Water Quality Bureau
1400 Broadway, A-206
P. O. Box 200901
Helena, MT 59620-0901
Phone (406) 444-2406

D. Records Retention

All records and information resulting from the monitoring activities required by this permit shall be retained for a minimum of three (3) years, or longer if requested by the Department.

E. Noncompliance Reporting

If, for any reason, the permittee does not comply with or will be unable to comply with any condition specified in this permit, the permittee shall notify as soon as possible by phone and provide the Department with the following information, in writing, within five (5) days of becoming aware of such condition:

a. A description of the discharge and cause of noncompliance; and

b. The period of noncompliance, including exact dates and times; or, if not correct, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrences of the non complying discharge.

F. Penalties for Tampering

The Montana Water Quality Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device, method or practice required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $25,000 per day of violation or imprisonment for not more than 1 year, or both.

PART IV.

IV. STANDARD PERMIT CONDITIONS

A. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give the Department advance notice of any planned changes at the permitted facility or of an activity which may result in permit noncompliance.

The Montana Water Quality Act (MCA 75-5-631) and the Federal Clean Water Act (section 309) provide significant penalties for any person who violates a permit condition. Any person who violates any condition of this permit is subject to a civil penalty not to exceed $25,000 per day of such violation, as well as any other appropriate sanction provided by section 309 of the Clean Water Act.

B. Continuation of the Expired Permit

An expired general permit continues in force and effect until a new general permit is issued. Only those facilities authorized to discharge under the expiring permit are covered by the continued permit.

C. Need to Halt or Reduce Activity not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting
human health or the environment.

E. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

F. Other Information

When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Department, it shall promptly submit such facts or information.

G. Signatory Requirements

All applications, reports or information submitted to the Department shall be signed and certified.

1. All permit applications shall be signed as follows:

a. For a corporation: by a responsible corporate officer;

b. For a partnership or sole proprietorship: By a general partner or the proprietor, respectively;

c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

a. The authorization is made in writing by a person described above and submitted to the Department, and,

b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph IV.G.2. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph IV.G.2. must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.

H. Certification

Any person signing a document under this section shall make the following certification:

"I certify under penalty of the law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

I. Penalties for Falsification of Reports

The Montana Water Quality Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance shall, upon conviction be punished by a fine of not more than $25,000 per day, or by imprisonment for not more than 1 year per violation, or by both.

J. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Clean Water Act.

K. Property Rights

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by section 510 of the Act.

N. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit and with the requirements of erosion control plans. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee only when necessary to achieve compliance with the conditions of the permit.

O. Inspection and Entry

The permittee shall allow the Department or the Regional Administrator, or authorized representative thereof, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;
2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;
3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,
4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance, any substances or parameters at any location.

P. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or notification of planned changes or anticipated noncompliance, does not stay any permit condition.

Q. Reopener Provision

If there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with construction activity covered by this permit, the owner or operator may be required to obtain an individual permit or an alternate general permit or the permit may be modified to include different limitations and/or requirements.

R. Notice of Termination

Where a site has been finally stabilized or where the operator or contractor at a site changes, the operator or contractor of the construction site may submit a Notice of Termination that is signed in accordance with Part IV.G. The Notice of Termination shall include the following information:

1. The mailing address of the construction site. Where a mailing address for the site is not available, the location of the site must be described as County, Township, Range, Section, and 1/4 Section;
2. The name, address and telephone number of the owner and contractor(s) involved with the site;
3. The MPDES permit number for the construction site;
4. An indication of whether the site has been permanently stabilized or the contractor(s) of the project has changed; and
5. The Notice of Termination must be certified and signed in accordance with Part IV.G. and IV.H.

The Notice of Termination shall be sent to the following address:

Montana Department of Health and Environmental Sciences
Water Quality Bureau, Room A206
1400 Broadway
P. O. Box 200901
Helena, MT 59620-0901

S. Definitions

1. The "Act" means the Federal Clean Water Act.
2. "Best Management Practices" ("BMPs") means schedule of activities, prohibition of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of state waters. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

3. "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility or a BMP.

4. The "Department" means the Montana Department of Health and Environmental Sciences.

5. "Permittee" for construction activity means both the owner of the property and the contractor(s) conducting the construction activity. For the purposes of this permit, the owner and the contractor(s) will be co-permittees under the storm water general permit.

6. The "receiving water" is the river, stream, lake, etc. which receives the discharge from your site.

7. "Severe Property Damage" means substantial physical damage to property, damage to treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

8. "Storm Water" means storm water runoff, snow melt runoff, and surface runoff and drainage.

USA wrestling Washington wrestlers pace Cadet division . . . . See SPORTS

The MONTANA STANDARD

50 cents

Wednesday, June 18, 1997

Crowd supports Ruby access plan

BY PERRY BACKUS
of The Montana Standard

SHERIDAN — There was little opposition Tuesday night to a plan to open portions of the Ruby River to the public, at the first of two public hearings.

About 50 people attended the meeting at the Sheridan High School cafeteria. A second public hearing on the proposal will be held at 7 p.m. tonight at the War Bonnet Inn in Butte.

The Montana Department of Fish, Wildlife and Parks proposes buying a 76-acre site with just under a mile of riverfront and leasing about 4.84 miles of river from four different entities. Officials said in one case, a smaller piece of property may be leased than was planned, because of concerns expressed by adjoining landowners.

The proposal is the culmination of efforts by the state and a citizens task force to resolve the public access issue along the 50-mile stretch of Ruby River from the Ruby Dam to where it empties into the Beaverhead River near Twin Bridges. Currently, there are no public access sites on that stretch of river.

While most of the comments

See ACCESS, Page A3

Rain, tailings run amok

Runoff overflows catch basin, may find its way back to creek

BY BETSY COHEN
of The Montana Standard

A river of yellow foam flowed over the exposed Colorado Tailings Friday night, at their new home atop the 80 acres of Clark Tailings and the old county landfill, possibly contaminating Grove Creek northeast of the property.

When county Commissioner Charlie O'Leary drove past the site for the county's new recreation park after Friday's downpour, he was surprised by the amount of water flowing over the tailing mounds that ARCO recently hauled from Silver Bow Creek.

"It was just unreal," O'Leary said. "It was a small river about 6 feet wide, just boiling down with yellow foam on top of the water," he said.

The color of foam, O'Leary said, matched the color of the zinc- and copper-laden piles of the Colorado Tailings which will be capped in the fall.

His concern is that storm water laden with mining wastes overflowed into the Grove Creek drainage system, which flows into Silver Bow Creek. O'Leary is also concerned that contaminated water flowed into the residential areas at the corner of Hanson, Beeftrail and Montana roads.

But neither ARCO nor the state Department of Environmental Quality say they are responsible for testing the creek water for contamination.

‘Our operation meets state regulations. Trace metals are not dealt with in storm water conditions," said Sandy Stash, ARCO's Montana facilities manager.

According to Pat Crowley, program manager for the state's solid waste program, ARCO's construction permit does not require ARCO to monitor the stormwater runoff.

And there are no laws in place that say the state has to test water downstream from the runoff, Crowley said.

"There's nothing I can do," said Crowley. Even though the area's test ground water wells have shown elevated levels of zinc since the construction project began this spring.

"There probably is some damage being done, but we are trying to control the runoff

See TAILINGS, Page A3

Panama to Anchorage

Racers make Butte pit stop

BY JENNIFER MCKEE
of The Montana Standard

The mag-wheel, roll-bar rod jocks who blew into Butte Tuesday night are not in love

and rebuilding both the engine and the frame to take the beating of nine countries' worth of potholes and pounding, drivers don't aim just for speed, but endurance, Brittan says.

ALPINA
BRIDGESTONE

Tailings ...

Continued from Page A1

through best management practice," he said.

According to Crowley, those "BMP's" include using hay bales to divert runoff, and the use of a settling pond which sits about 12 feet above Grove Creek.

Larry Smith, U.S. Environmental Protection Agency construction inspector, said the source of the water is runoff from Timber Butte which pooled 6 inches deep in an acre-size section of the construction site over the weekend.

The water then flowed downhill over the raw tailings, under ARCO's haul road and flowed about two feet over the drainage pipe at the site's settling pond, Smith said.

"We need to figure out a way to control the runoff and protect the creek. It's evident that there's a mistake here and we have a problem," Smith said Monday when he toured the site with a reporter.

While neither the DEQ nor EPA have yet tested the water or the sediment in Grove Creek, the amount of debris found on the drainpipe at the settling pond, and the yellow residue which marks the high water level, indicate that contaminated water did go down the drainpipe and into the creek, Smith said.

Crowley admits that the settling pond's shallow basin has always been a concern during the construction, commenting "It just doesn't do the job."

He said he has directed ARCO to deepen and widen the pond as soon as the area dries out, after the rainy season, later in the summer.

Meanwhile, June's wet weather has put the state and federal agencies in a predicament they do not quite know how to deal with, leaving some Grove Creek residents in a lurch.

"Currently none is responsible (for monitoring downstream runoff)," Crowley said.

About 2 feet of water and sediment flooded into the garage at Joe Seymour's business, Seymour Livestock, after Friday's rain. Seymour's trucking business sits along the creek and below the recreation site.

"The culverts are full of silt from the tailings, and I'm concerned about the mining wastes," Seymour said. He hired a crew to pump out the debris.

Seymour said he remembers swimming in the creek when he was a boy. "There were even fish living in it," he said. "But now, I worry about everyone's health because of the creek."

After last week's storm, Seymour's cow died. "I wish I had an autopsy done of it because I'm pretty sure it drank bad water from the creek," he said.

Seymour's neighbor, Margie Reap, feels that the agencies, ARCO and the county have turned their backs on the runoff issue.

"We went to all of the public hearings and told everyone that there was going to be a problem with the runoff," said Reap, who owns 13 acres along the creek.

"We knew the water would go over the catch basin, but they all said it wouldn't. Well it happened, we saw it happen, and it came down through our property," she said.

Sara Weinstock with the EPA Butte office said Tuesday that her agency will test the sediment "as soon as possible."

"I know this is frustrating for people, but we are concerned with people's health, and we want to make sure Grove Creek doesn't have any elevated levels of metals," she said.

Which has relieved Commissioner O'Leary.

"Seems to me that there is a reasonable chance that a mixture of contaminated liquid and soil went downstream," O'Leary said. "Hopefully I'll be proved wrong, but there is some sense of urgency here and all parties involved should be digging in as fast as they can to determine contamination."

Access ...

Continued from Page A1

presented to state officials Tuesday night were positive, there was concern about wording in the lease agreements that didn't guarantee the public's right to launch small boats. The Department of Fish, Wildlife and Parks followed recommendations from the citizens task force not to develop boat ramps because the narrow river is better fished by wading or from its banks.

Karen Hilstrom of the state agency said while the lease agreements didn't guarantee boat-launching rights, landowners could allow that kind of use. On the property the state plans to purchase, Hilstrom said a policy will have to be developed.

Jim Short, a Sheridan businessman and task force member, said he didn't believe

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RFI - REQUEST FOR INFORMATION

DATE 5/23/97	RFI NO. 35 INITIATED BY: ARCO	CONTRACTOR Barnard Construction	CONTRACT NO. M96532

CONTRACT DESCRIPTION: LAO Phase I, Segment II Excavation and Clark Tailings Disposal	ATTENTION OF: Barnard

SUBJECT:
○ ELECTRICAL ○ MECHANICAL ● CIVIL ○ STRUCTURAL/ARCHITECTURAL ○ INSTRUMENTATION

OPERABLE UNIT: LAO MAJOR WORK TASK: Phase I, Segment II Construction WBS NUMBER:	REFERENCE DWG., P.O., TAG, SPECIFICATION NO. (FOR DEVIATIONS OR DEFICIENCIES) ETC: Attached Clark Tailings Final Construction Drawings

DESCRIPTION:

All final Clark Tailings construction drawings are attached to this RFI. The fill plan and cross sections were issued several weeks ago, but are also included in the attached drawings. Any future changes to these drawings will be addressed via RFIs.

	○ Design Deficiency ○ Engineering Change Request ○ Agency Directive ○ Construction Deficiency ○ Schedule	○ Material Substitution ○ Vendor Material Deficiency ○ Scope ● Clarification/Information ○ Other ________	ARCO Representative: 5/23/97

RESPONSE/DIRECTIVE:

These drawings have been reviewed and approved by the State of Montana Solid Waste Bureau.

CC: : Construction Supervisor: Eric Jacobsen (w/attachments)
File: RFI Log
Project Manager: Chuck Stilwell (w/attachment)
Other: Ron Ziegler/ARCO; George Brooks/ARCO (w/attachment); Sally Dickerson/ARCO; Traci Blackwood/ARCO; Dick Talley/MSE-HKM; Todd Erickson/MSE-HKM (w/attachment); Scott Hurley/MSE-HKM (w/attachment); Barnard Construction (w/attachment); Ron Bertram/EPA; Ken Brockman/EPA (w/attachment); Larry Smith/EPA (w/attachment); Kevin Kirley/State of Montana; Nancy Dessenberger/ESA; Rick Larson/BSB; Pat Crowley/MDEQ Solid Waste; Bob Alexander/CDM

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Corporate Environmental Remediation
ARCO

RFI - REQUEST FOR INFORMATION

RECEIVED
JUN 17 1997
DEPT. OF ENVIRONMENTAL QUALITY
MONTANA
COMMUNITY SERVICES BUREAU

DATE 5/19/97	RFI NO. 33 INITIATED BY: ARCO	CONTRACTOR Barnard Construction	CONTRACT NO. M96532
CONTRACT DESCRIPTION: LAO Phase I, Segment II Excavation and Clark Tailings Disposal		ATTENTION OF: Barnard	

SUBJECT:
○ ELECTRICAL ○ MECHANICAL ● CIVIL ○ STRUCTURAL/ARCHITECTURAL ○ INSTRUMENTATION

OPERABLE UNIT: LAO MAJOR WORK TASK: Phase I, Segment II Construction WBS NUMBER:	REFERENCE DWG., P.O., TAG, SPECIFICATION NO. (FOR DEVIATIONS OR DEFICIENCIES) ETC: Attached memo from Pioneer Technical Services.

PROBLEM/CHANGE DESCRIPTION:

The final Clark Tailings Technical Specifications require horizontal lift placement for fill at Clark Tailings. However, Pioneer Technical Services (Brad Archibald) initially granted a variance to place normal to existing subgrade slopes of 6H:1V or flatter for the first two lifts due to soft subgrade conditions at Clark Tailings.

Barnard has since requested to place normal to existing slopes of 6:1 or flatter when necessary over the entire fill plan at Clark Tailings. Barnard founded their request on a 6H:1V or flatter slope allowance stated in the Montana Department of Transportation (MDT) Standard Specifications (which are referenced in the Clark Tailings specifications) and confirmed the appropriateness of this specification during a conversation with a MDT engineer. Barnard has indicated their preference to place horizontal lifts at Clark Tailings to the extent conditions allow, but wishes to have the flexibility to place normal to the slope if needed.

ARCO and Pioneer confirmed the 6:1 or flatter slope specification with an MDT engineer (Mr. Cal Frank). Pioneer then evaluated whether the 6:1 specification would be acceptable at Clark Tailings and deemed it appropriate under the conditions specified in the attached memo. In addition to the conditions specified in the memo, Barnard must verify that slopes are 6:1 or flatter prior to placing fill and must provide ARCO with proof accordingly.

	○ Design Deficiency ● Engineering Change Request ○ Agency Directive ○ Construction Deficiency ○ Schedule	○ Material Substitution ○ Vendor Material Deficiency ○ Scope ● Clarification/Information ○ Other ____________	ARCO Representative: 5/19/97

RESPONSE/DIRECTIVE:

See attached memo from Pioneer Technical Services for details. Horizontal lifts should be placed at Clark Tailings as often as possible; however, placing on 6:1 or flatter slopes is acceptable when necessary per this RFI. Barnard and ARCO concur that as the depth of fill increases slightly above current elevations, horizontal lift placement will become more and more practical and will be the preferred placement method.

CC: : Construction Supervisor: Eric Jacobsen (w/attachments)
File: RFI Log (w/attachment)
Project Manager: Chuck Stilwell (w/attachment)
Other: Ron Ziegler/ARCO (w/attachment); George Brooks/ARCO (w/attachment); Sally Dickerson/ARCO (w/attachment); Traci Blackwood/ARCO(w/attachment); Dick Talley/MSE-HKM (w/attachments); Todd Erickson/MSE-HKM (w/attachment); Scott Hurley/MSE-HKM (w/attachment); Barnard Construction (w/attachment); Ron Bertram/EPA (w/attachment); Ken Brockman/EPA (w/attachment); Larry Smith/EPA (w/attachment); Kevin Kirley/State of Montana (w/attachment); Nancy Dessenberger/ESA(w/attachment); Rick Larson/BSB (w/attachment); Pat Crowley/MDEQ Solid Waste (w/attachment); Bob Alexander/CDM (w/attachment)

PIONEER
TECHNICAL SERVICES, INC
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

MEMORANDUM

DATE: May 15, 1997

TO: Eric Jacobsen, ARCO

FROM: Brad Archibald BOA

RE: Placing and compacting materials along slope at Clark Tailings

Barnard has asked that we allow them to place and compact the LAO materials along slopes rather than as horizontal lifts as required in the specifications. Barnard claims that the Montana Department of Transportation Standard Specifications, which are included by reference in the Clark Tailings specifications, allow placement and compaction of embankment materials along slopes no greater than 6 horizontal:1 vertical. You and I verified this via a telephone conversation with an MDT engineer this morning. Therefore, placement and compaction of fill materials along slopes is acceptable, provided the following conditions are satisfied:

1. Slopes do not exceed 6 horizontal:1 vertical.
2. The specified compaction densities are achieved. (Note that this may take additional passes of compaction equipment than on horizontal lifts.)
3. Lift thicknesses are maintained in accordance with the specifications. It will be important to monitor the toe of the slope since materials may accumulate here, leading to lift thicknesses greater than specified.
4. Each lift is scarified to a minimum depth of two inches before placing subsequent lifts, to ensure that lifts are bonded together and to minimize the potential for a failure plane along a lift boundary.

PIONEER
TECHNICAL SERVICES, INC.
P.O. Box 3445, Butte, Montana 59702 PHONE (406) 782-5177 FAX (406) 782-586

Fax Transmittal

TO:	PAT CROWLEY
Company:	MDEQ
Fax No.:	444-1374
FROM:	BRAD ARCHIBALD
Date:	6/18/97
Comments:	FROM TODAY'S STANDARD.
Pages (including cover):	3

stlers pace Cadet division . . . . See SPORTS

ONTANA STANDARD
June 18, 1997

Rain, tailings run amok

Runoff overflows catch basin, may find its way back to creek

By Betsy Cohen
of The Montana Standard

A river of yellow foam flowed over the exposed Colorado Tailings Friday night, at their new home atop the 80 acres of Clark Tailings and the old county landfill, possibly contaminating Grove Creek northeast of the property.

When county Commissioner Charlie O'Leary drove past the site for the county's new recreation park after Friday's downpour, he was surprised by the amount of water flowing over the tailing mounds that ARCO recently hauled from Silver Bow Creek.

"It was just unreal," O'Leary said. "It was a small river about 6 feet wide, just boiling down with yellow foam on top of the water," he said.

The color of foam, O'Leary said, matched the color of the zinc- and copper-laden piles of the Colorado Tailings which will be capped in the fall.

His concern is that storm water laden with mining wastes overflowed into the Grove Creek drainage system, which flows into Silver Bow Creek. O'Leary is also concerned that contaminated water flowed into the residential areas at the corner of Hanson, Beeftrail and Montana roads.

But neither ARCO nor the state Department of Environmental Quality say they are responsible for testing the creek water for contamination.

'Our operation meets state regulations. Trace metals are not dealt with in storm water conditions," said Sandy Stash, ARCO's Montana facilities manager.

According to Pat Crowley, program manager for the state's solid waste program, ARCO's construction permit does not require ARCO to monitor the stormwater runoff.

And there are no laws in place that say the state has to test water downstream from the runoff, Crowley said.

"There's nothing I can do," said Crowley. Even though the area's test ground water wells have shown elevated levels of zinc since the construction project began this spring.

"There probably is some damage being done, but we are trying to control the runoff

See TAILINGS, Page A3

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MONTANA

Tailings ...

Continued from Page A1

through best management practice," he said.

According to Crowley, those "BMP's" include using hay bales to divert runoff, and the use of a settling pond which sits about 12 feet above Grove Creek.

Larry Smith, U.S. Environmental Protection Agency construction inspector, said the source of the water is runoff from Timber Butte which pooled 6 inches deep in an acre-size section of the construction site over the weekend.

The water then flowed downhill over the raw tailings, under ARCO's haul road and flowed about two feet over the drainage pipe at the site's settling pond, Smith said.

"We need to figure out a way to control the runoff and protect the creek. It's evident that there's a mistake here and we have a problem," Smith said Monday when he toured the site with a reporter.

While neither the DEQ nor EPA have yet tested the water or the sediment in Grove Creek, the amount of debris found on the drainpipe at the settling pond, and the yellow residue which marks the high water level, indicate that contaminated water did go down the drainpipe and into the creek, Smith said.

Crowley admits that the settling pond's shallow basin has always been a concern during the construction, commenting "It just doesn't do the job."

He said he has directed ARCO to deepen and widen the pond as soon as the area dries out, after the rainy season, later in the summer.

Meanwhile, June's wet weather has put the state and federal agencies in a predicament they do not quite know how to deal with, leaving some Grove Creek residents in a lurch.

"Currently none is responsible (for monitoring downstream runoff)," Crowley said.

About 2 feet of water and sediment flooded into the garage at Joe Seymour's business, Seymour Livestock, after Friday's rain. Seymour's trucking business sits along the creek and below the recreation site.

"The culverts are full of silt from the tailings, and I'm concerned about the mining wastes," Seymour said. He hired a crew to pump out the debris.

Seymour said he remembers swimming in the creek when he was a boy. "There were even fish living in it," he said. "But now, I worry about everyone's health because of the creek."

After last week's storm, Seymour's cow died. "I wish I had an autopsy done of it because I'm pretty sure it drank bad water from the creek," he said.

Seymour's neighbor, Margie Reap, feels that the agencies, ARCO and the county have turned their backs on the runoff issue.

"We went to all of the public hearings and told everyone that there was going to be a problem with the runoff," said Reap, who owns 13 acres along the creek.

"We knew the water would go over the catch basin, but they all said it wouldn't. Well it happened, we saw it happen, and it came down through our property," she said.

Sara Weinstock with the EPA Butte office said Tuesday that her agency will test the sediment "as soon as possible."

"I know this is frustrating for people, but we are concerned with people's health, and we want to make sure Grove Creek doesn't have any elevated levels of metals," she said.

Which has relieved Commissioner O'Leary.

"Seems to me that there is a reasonable chance that a mixture of contaminated liquid and soil went downstream," O'Leary said. "Hopefully I'll be proved wrong, but there is some sense of urgency here and all parties involved should be digging in as fast as they can to determine contamination."

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Corporate Environmental Remediation
ARCO

RFI - REQUEST FOR INFORMATION

DATE 5/19/97	RFI NO. 34 INITIATED BY: ARCO	CONTRACTOR Barnard Construction	CONTRACT NO. M96532

CONTRACT DESCRIPTION:
LAO Phase I, Segment II Excavation and Clark Tailings Disposal

ATTENTION OF: Barnard

SUBJECT:
○ ELECTRICAL ○ MECHANICAL ● CIVIL ○ STRUCTURAL/ARCHITECTURAL ○ INSTRUMENTATION

OPERABLE UNIT: LAO

MAJOR WORK TASK: Phase I, Segment II Construction

WBS NUMBER:

REFERENCE DWG., P.O., TAG, SPECIFICATION NO. (FOR DEVIATIONS OR DEFICIENCIES) ETC: Attached memo and drawings from Pioneer Technical Services.

PROBLEM/CHANGE DESCRIPTION:

With the institution of "marbled" fill areas at Clark Tailings for debris and extremely soft materials and given the potential volume of peat/clay from LAO which will be used as capping material rather than fill, the total fill volume at Clark Tailings may be less than originally designed. Therefore, Pioneer has developed maximum interim proposed fill elevations from STA 13+00 to STA 18+00 (see attached drawings). This would leave the hump on the northern part of the fill plan as the last remaining area to place material excavated from LAO. In discussing this issue previously with Barnard, placing in the northern hump area near the end of the project works well with their Clark Tailings fill plan.

○ Design Deficiency
○ Engineering Change Request
○ Agency Directive
○ Construction Deficiency
○ Schedule

○ Material Substitution
○ Vendor Material Deficiency
○ Scope
● Clarification/Information
○ Other ______________

ARCO Representative:

RESPONSE/DIRECTIVE:

The interim proposed fill elevations shown on the attached cross-sections will be the preferred placement elevations at Clark Tailings subject to potential changes by Barnard in their fill plan due to unforeseen conditions and subject to the actual final volume excavated from LAO.

CC: : Construction Supervisor: Eric Jacobsen (w/attachments)
File: RFI Log (w/attachment)
Project Manager: Chuck Stilwell (w/attachment)
Other: Ron Ziegler/ARCO (w/attachment); George Brooks/ARCO (w/attachment); Sally Dickerson/ARCO (w/attachment); Traci Blackwood/ARCO(w/attachment); Dick Talley/MSE-HKM (w/attachments); Todd Erickson/MSE-HKM (w/attachment); Scott Hurley/MSE-HKM (w/attachment); Barnard Construction (w/attachment); Ron Bertram/EPA (w/attachment); Ken Brockman/EPA (w/attachment); Larry Smith/EPA (w/attachment); Kevin Kirley/State of Montana (w/attachment); Nancy Dessenberger/ESA(w/attachment); Rick Larson/BSB (w/attachment); Pat Crowley/MDEQ Solid Waste (w/attachment); Bob Alexander/CDM (w/attachment)

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PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

MEMORANDUM

DATE: May 12, 1997

TO: Eric Jacobsen, ARCO

FROM: Brad Archibald BDA

RE: Clark Tailings Fill Volume Analysis

At your request, I have assessed how the grading plan at the Clark Tailings may be affected if the fill volumes are decreased.

The design fill volume is based on a LAO excavation volume of 850,000 cubic yards (cy). As we have discussed, the fill plan is based on 15% shrinkage of the LAO materials when they are compacted at the Clark Tailings, so that they will occupy 723,000 cy when compacted.

The fill volume shown on the current set of drawings is approximately 913,000 cy. Of this, 288,000 cy will be occupied by the cap (39 inches over 55 acres). This leaves 625,000 cy of volume available for waste disposal. This is based on approximately 100,000 cy of peat/clay materials (from the 723,000 cy of compacted waste volume) being removed from the waste fill and used as infiltration barrier layer (cap) materials. (These numbers may not all add up evenly due to rounding. Also, remember that all volumes associated with the cap are approximate because the area of the cap may change based on field conditions.) The 100,000 cy estimate of peat/clay was based on discussions with you during the development of the fill plan.

According to Dick Talley of MSE-HKM, the latest estimate is that 204,000 cy of peat/clay materials will be excavated from the LAO. Based on 15% shrinkage, this equates to 173,000 cy compacted in place at the Clark Tailings. However, this estimate is based on a limited amount of data (only one soil boring per four acres), so there is a potential for a wide margin of error. Up to 133,00 cy of this material (compacted) may be used for the infiltration barrier layer. The actual volume used for the infiltration barrier layer will most likely by closer to 120,000 compacted cy, considering a portion of the cap will consist of geosynthetic liner (the pond area and the area under the western diversion ditch). Therefore, up to approximately 50,000 cy of excess peat/clay may be placed at the Clark Tailings as waste materials, either within the non-structural fill or within the debris/marbled waste disposal areas.

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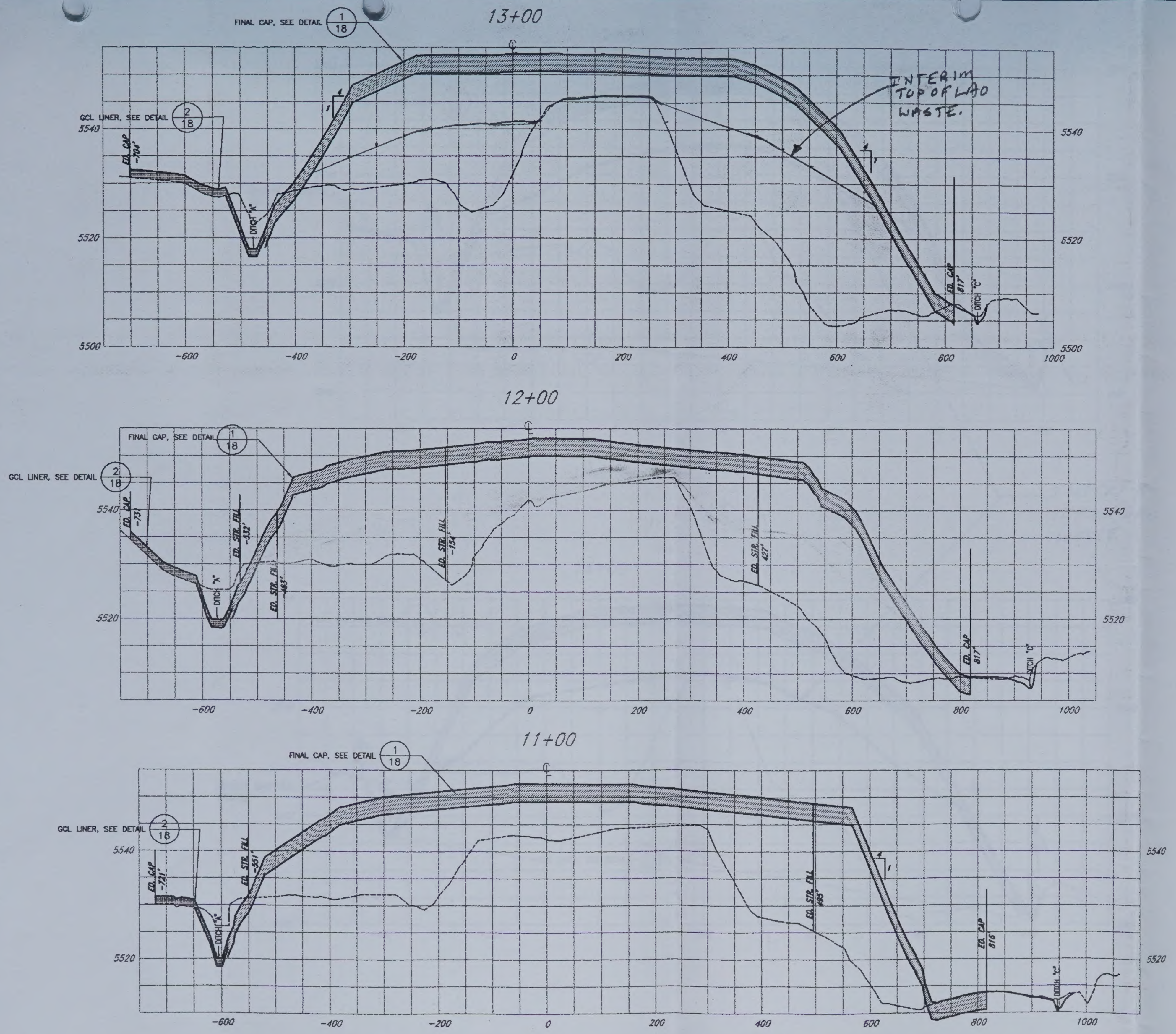
You have told me that the overall excavation volume may be only 825,000 cy (or 21,000 compacted cy less the original estimate). Furthermore, marbled wastes are being separated from the fill plan and are being placed at the perimeter of the fill. For purposes of this analysis, I have assumed that a total of 60,000 cy of marbled materials or peat/clay not used in the cap will be removed from the fill and placed at the perimeter of the repository. Also, it appears that more peat/clay material may be available for use as the infiltration barrier layer. Up to 133,000 cy of this material is required for the infiltration barrier layer, so an additional 33,000 cy may be removed from the fill. Therefore, the fill volume may be decreased by 114,000 cy. Some of this decrease will be offset by an estimated 10,000 to 15,000 cy of surficial tailings (2 to 3 feet over approximately 3 acres) that will be removed from the periphery of the Clark Tailings and placed within the fill area.

This volume of fill would best be removed from the non-structural fill area between approximately stations 13+00 to 18+00. By decreasing the final elevation of the fill in this area by 10 feet, the fill volume is decreased by approximately 110,000 cy, as shown on the attached cross sections. I recommend that Barnard initially not fill past the elevations shown on these cross sections. When we are closer to the end of the project and have a better feel for the total volume to be excavated; the shrinkage factor on the materials; and the volume of materials that have been removed from the fill (both marbled and cap materials), we can re-analyze the area and determine final grades.

As shown on the drawings, we have identified approximately 15,000 cy of capacity for marbled materials on the east side of the fill between stations 7+00 and 12+00. Additional capacity for these materials is available on the west side of the fill, between the diversion ditch on the west side and the edge of cap shown on the drawings. Grading will be required in this area, as shown on the cross sections, to maintain drainage toward the ditch. These materials can be used for fill to establish preferred drainage patterns. If it becomes necessary to fill to grades that interrupt overland flow toward the ditch (basically constructing a dike from marbled fill materials), we will need to install drainage features to ensure that no ponding occurs at the toe of the dike. Most likely, it will require a culvert under the dike in the vicinity of well BSB-A2. Another culvert may be needed more to the north if the dike extends in that direction.

There is not a large volume available for disposal of large debris and/or marbled fill. Therefore, the materials that are allowed to be placed in these areas must be carefully selected. When we have good weather, Barnard should attempt to spread and dry marginal materials and place them within the non-structural fill.


13+00
FINAL CAP, SEE DETAIL 1/18
GCL LINER, SEE DETAIL 2/18
INTERIM TOP OF LAO WASTE.
ED. CAP -704'
DITCH "A"
ED. CAP 817'
DITCH "C"
4
1
5540
5520
5500
-600
-400
-200
0
200
400
600
800
1000
12+00
FINAL CAP, SEE DETAIL 1/18
GCL LINER, SEE DETAIL 2/18
ED. CAP -731'
DITCH "A"
ED. STR. FILL -532'
ED. STR. FILL -463'
ED. STR. FILL -154'
ED. STR. FILL 427'
ED. CAP 817'
DITCH "C"
11+00
FINAL CAP, SEE DETAIL 1/18
GCL LINER, SEE DETAIL 2/18
ED. CAP -721'
DITCH "A"
ED. STR. FILL -551'
ED. STR. FILL 495'
ED. CAP 816'
DITCH "C"
4
1

CHECK SCALE

IF THIS BAR IS NOT 1-INCH LONG, THE DRAWING IS NOT TO THE SCALE NOTED.

DATA\PRD\4502\Y-SEC0

NO.	BY	DATE	REVISION DESCRIPTION

LJT DRAWN
TR/BOA DESIGNED
SDB CHECKED
BOA APPROVED
4/23/97 DATE
4502 PROJECT NO.

SCALE
HORIZ: 1"=100' VERT: 1"=10'
SCALE IN FEET
0 100 200

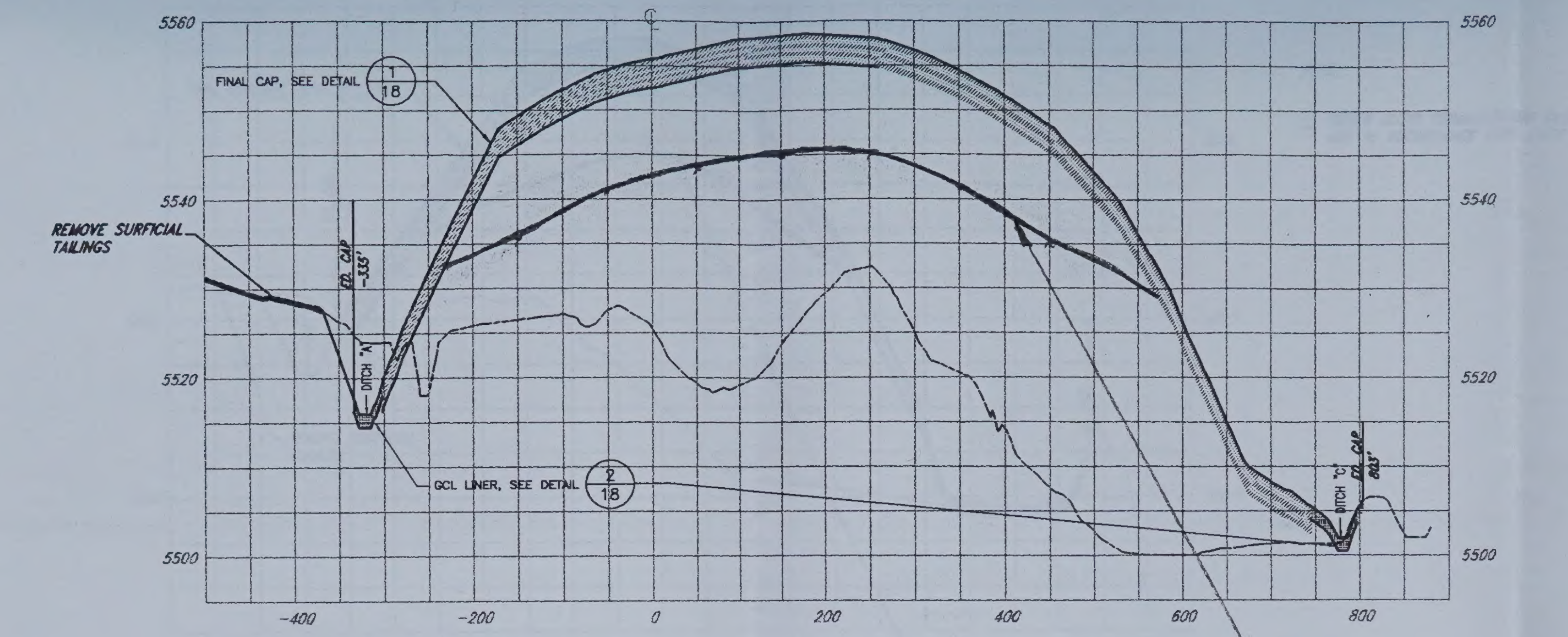
PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59702

ARCO
LAO\CLARK TAILINGS
DISPOSAL AREA

CROSS SECTIONS
11+00 TO 13+00

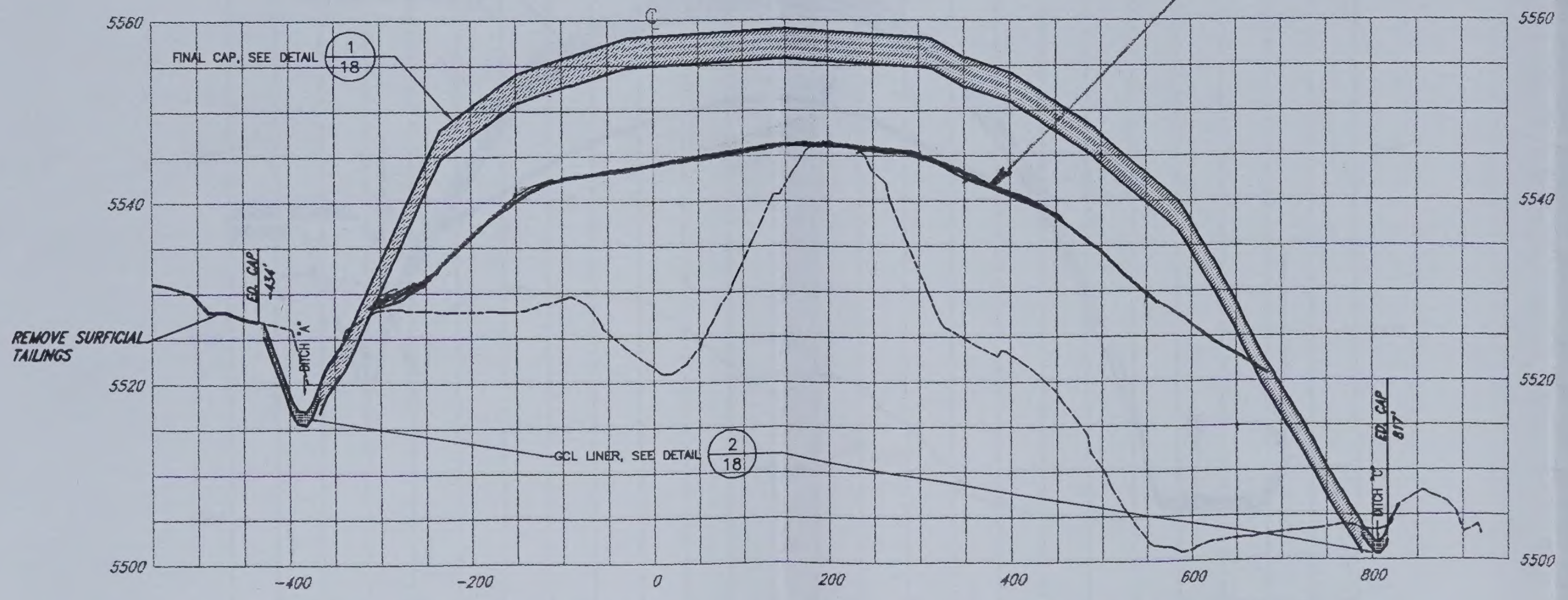
SHEET
C-11

15+00


℄
5560
5540
5520
5500
FINAL CAP, SEE DETAIL 1/18
REMOVE SURFICIAL TAILINGS
ED. CAP -335'
DITCH 'A'
GCL LINER, SEE DETAIL 2/18
DITCH "C"
ED. CAP 803'
-400
-200
0
200
400
600
800

INTERIM
TOP OF LAO
WASTE

14+00


℄
5560
5540
5520
5500
FINAL CAP, SEE DETAIL 1/18
REMOVE SURFICIAL TAILINGS
ED. CAP -434'
DITCH "A"
GCL LINER, SEE DETAIL 2/18
DITCH "C"
ED. CAP 817'
-400
-200
0
200
400
600
800

CHECK SCALE

IF THIS BAR IS NOT 1-INCH LONG, THE DRAWING IS NOT TO THE SCALE NOTED.

DATA\BRKD\4502\X-SEC0

NO.	BY	DATE	REVISION DESCRIPTION

LJT DRAWN	TR/BOA DESIGNED	SDB CHECKED
BOA APPROVED	4/23/97 DATE	4502 PROJECT NO.

SCALE
HORIZ: 1"=100' VERT: 1"=10'
SCALE IN FEET
0 100 200

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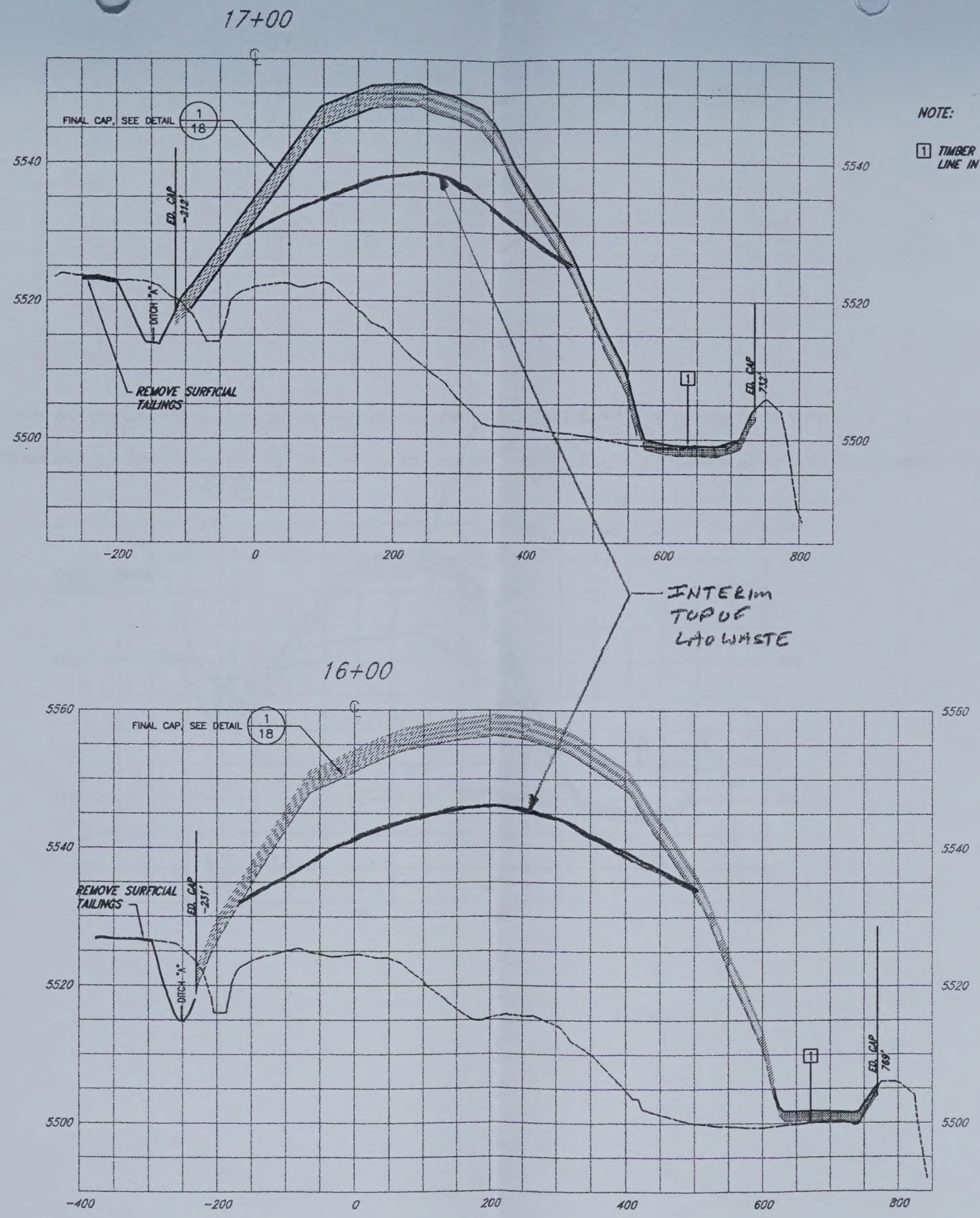
P.O. BOX 3445
BUTTE, MT 59702

ARCO
LAO/CLARK TAILINGS
DISPOSAL AREA

CROSS SECTIONS
14+00 to 15+00

SHEET
C-12


17+00
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FINAL CAP, SEE DETAIL 1/18
ED. CAP -212'
DITCH "A"
REMOVE SURFICIAL TAILINGS
1
ED. CAP 732'
5540
5520
5500
-200
0
200
400
600
800
INTERIM TOP OF LAO WASTE
16+00
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FINAL CAP, SEE DETAIL 1/18
REMOVE SURFICIAL TAILINGS
ED. CAP -231'
DITCH "A"
1
ED. CAP 769'
5560
5540
5520
5500
-400
-200
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800

NOTE:

1. TIMBER BUTTE SEDIMENTATION BASIN, LINE IN ACCORDANCE WITH SHEET C-22.

CHECK SCALE

IF THIS BAR IS NOT 1-INCH LONG, THE DRAWING IS NOT TO THE SCALE NOTED.

NO.	BY	DATE	REVISION DESCRIPTION

LJT DRAWN
TR/BOA DESIGNED
SDB CHECKED
BOA APPROVED
4/23/97 DATE
4502 PROJECT NO.

SCALE
HORIZ: 1"=100' VERT: 1"=10
SCALE IN FEET
0 100 200

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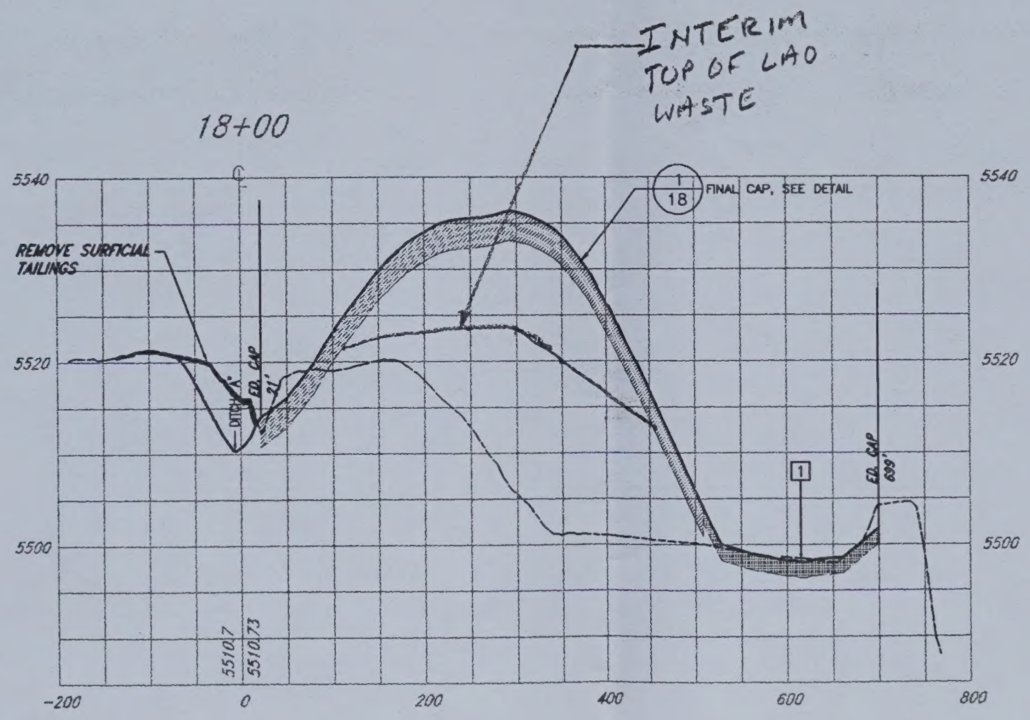
P.O. BOX 3445
BUTTE, MT 59702

ARCO
LAO/CLARK TAILINGS
DISPOSAL AREA

CROSS SECTIONS
16+00 TO 17+00.

SHEET
C-13


INTERIM TOP OF LAO WASTE
18+00
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5500
REMOVE SURFICIAL TAILINGS
DITCH "A"
ED. CAP 21'
1/18
FINAL CAP, SEE DETAIL
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ED. CAP 699'
5510.7
5510.73
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600
800

NOTE:

1 TIMBER BUTTE SEDIMENTATION BASIN,
LINE IN ACCORDANCE WITH SHEET C-22.

CHECK SCALE
IF THIS BAR IS NOT 1-INCH LONG, THE DRAWING IS NOT TO THE SCALE NOTED.

DATA\BOA\4502\X-SECS

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SCALE IN FEET
0 100 200

PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59702

ARCO
CLARK/LAO TAILINGS
DISPOSAL AREA

CROSS SECTIONS
18+00

SHEET
C-14

PIONEER
TECHNICAL SERVICES, INC.

P.O. BOX 3445 BUTTE, MONTANA 59702
PHONE (406) 782-5177 FAX (406) 782-5866
e-mail pioneer@in-tch.com internet www.pioneer-technical.com

MEMORANDUM

File-
Clark Eng./Design

CONFIDENTIAL
PRIVILEGED ATTORNEY-CLIENT COMMUNICATION
ATTORNEY WORK PRODUCT
PREPARED IN ANTICIPATION OF LITIGATION

TO: Eric Jacobsen, ARCO

FROM: Brad Archibald

DATE: June 6, 1997 BA

RE: Fill Placement at Clark Tailings

This memo is a follow-up to our meeting today at the Clark Tailings. In addition to you and I, Dan Schall, Mike Jenkins, and Larry Bowar (Barnard); Larry Smith (EPA); Scott Hurley (MSE-HKM); and Deanna Anderson were also present at the meeting.

The purpose of the meeting was to discuss scarification requirements between fill lifts. The specification for placement of Type I fill reads (in both the June 1996 and April 1997 technical specifications):

> *"All surfaces upon or against which fill will be placed, including previously placed and compacted layers shall be clean of all objectionable materials; shall be moist but free of standing or ponded water; and shall be scarified as necessary, so as to provide a suitable bond between the existing and newly placed materials."* (Section 02210-7, 3.04.B.2)

Based on my observations to date, including those at the site today, it appears that the tire tracks from the haul trucks are adequately scarifying the underlying surface before the placement of ensuing lifts. This is particularly true on the relatively flat slopes at the site (less than 10%). If Barnard continues to operate in this way, this method of scarifying should continue to be adequate. On relatively flat areas in the southern portion of the fill where truck traffic will be minimal (such as the area on the eastern portion of the fill that we observed today), it appears that the area is adequately scarified from the wheels of the compactor if thematerial is the sandy tailings. When there are more fines in the fill (to the point where it exhibits plasticity), it is imperative that we scarify the underlying lift (via truck traffic, the dozer, or some other means) before placing the next lift. In any event, the more Barnard is able to run trucks over the underlying lift and roughen the surface, the better off we'll be.

On steeper slopes (from 10:1 to 6:1), we must scarify the surface to ensure good bonding of lifts. This may be accomplished by trucks backing onto the fill, tracking the underlying lift with the dozer, or some other means. Whatever method is used, we must achieve the two-inch scarification depth mentioned in my May 15, 1997 memo.

cc: Hurley/MSE; Erickson/MSE; Barnard; Smith/EPA; Brockman/EPA
Stilwell/ARCO; Brooks/ARCO; Crowley/MDEQ.

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Corporate Environmental Remediation
ARCO

RFI - REQUEST FOR INFORMATION

DATE 5/12/97	RFI NO. 30 INITIATED BY: ARCO	CONTRACTOR Barnard Construction	CONTRACT NO. M96532
CONTRACT DESCRIPTION: LAO Phase I, Segment II Excavation and Clark Tailings Disposal		ATTENTION OF: Barnard	

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○ ELECTRICAL ○ MECHANICAL ● CIVIL ○ STRUCTURAL/ARCHITECTURAL ○ INSTRUMENTATION

OPERABLE UNIT: LAO

MAJOR WORK TASK: Phase I, Segment II Construction

WBS NUMBER:

REFERENCE DWG., P.O., TAG, SPECIFICATION NO. (FOR DEVIATIONS OR DEFICIENCIES) ETC: Attached memo from Dick Talley (MSE-HKM) and peat/clay contour maps supplied by ESA.

RFI DESCRIPTION:

Estimation of peat/clay volume on LAO and contour map of peat/clay above EPA excavation grade.

○ Design Deficiency
○ Engineering Change Request
○ Agency Directive
○ Construction Deficiency
○ Schedule

○ Material Substitution
○ Vendor Material Deficiency
○ Scope
● Clarification/Information
○ Other ____________________

ARCO Representative:
5/12/97.

RESPONSE/DIRECTIVE:

CC: : Construction Supervisor: Eric Jacobsen (w/attachments)
File: RFI Log
Project Manager: Chuck Stilwell (w/attachment)
Other: Ron Ziegler/ARCO; George Brooks/ARCO; Sally Dickerson/ARCO; Traci Blackwood/ARCO; Dick Talley/MSE-HKM (w/attachments); Todd Erickson/MSE-HKM; Scott Hurley/MSE-HKM; Barnard Construction (w/attachment); Ron Bertram/EPA; Ken Brockman/EPA (w/attachment); Larry Smith/EPA (w/attachment); Kevin Kirley/State of Montana; Nancy Dessenberger/ESA; Rick Larson/BSB; Pat Crowley/MDEQ Solid Waste.,
Bob Alexander/CDM.

RECEIVED
MAY 14 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Kei

Engineering
MSE-HKM, Inc.
220 N. Alaska St.
P.O. Box 4078
Butte, Montana 59702
Phone (406) 723-8213
Fax (406) 723-8328

Other Offices:
Billings, MT (406) 656-6399
Boise, ID (208) 383-9506
Bozeman, MT (406) 586-8834
Helena, MT (406) 443-7335
Miles City, MT (406) 232-6666
Sheridan, WY (307) 672-9006

MEMORANDUM

TO: Eric Jacobsen

FROM: Dick Talley Dick Talley

DATE: May 9, 1997

At your request, MSE-HKM, Inc. is providing you with the following information summarized from my memo to you dated May 1, 1997.

I have completed the modeling you requested to determine the volume of peat material that exists within the LAO site above the EPA required contours. This volume calculation was completed utilizing the contour file provided by ESA of the existing peat lenses as compared to the existing EPA required contour model. Utilizing these two models, we have determined that approximately 204,661 cubic yards of peat is available. I caution you on the use of this quantity due to the vagueness and uncertainty of the top of the peat lens, as identified in the model we received from ESA. This model was constructed using 31 points for a surface area of 120± acres which tends to lessen the degree of accuracy the model represents.

Corporate Environmental Remediation
ARCO

RFI - REQUEST FOR INFORMATION

DATE 5/1/97	RFI NO. 32 INITIATED BY: ARCO	CONTRACTOR Barnard Construction	CONTRACT NO. M96532
CONTRACT DESCRIPTION: LAO Phase I, Segment II Excavation and Clark Tailings Disposal		ATTENTION OF: Barnard	

SUBJECT:
○ ELECTRICAL ○ MECHANICAL ● CIVIL ○ STRUCTURAL/ARCHITECTURAL ○ INSTRUMENTATION

OPERABLE UNIT: LAO MAJOR WORK TASK: Phase I, Segment II Construction WBS NUMBER:	REFERENCE DWG., P.O., TAG, SPECIFICATION NO. (FOR DEVIATIONS OR DEFICIENCIES) ETC: Attached memo and laboratory data from Brad Archibald.

RFI DESCRIPTION:

Moisture specification clarification for Clark Tailings non-structural fill areas.

	○ Design Deficiency ○ Engineering Change Request ○ Agency Directive ○ Construction Deficiency ○ Schedule	○ Material Substitution ○ Vendor Material Deficiency ○ Scope ● Clarification/Information ○ Other ______________	ARCO Representative: George W. Langston

RESPONSE/DIRECTIVE:

CC: : Construction Supervisor: Eric Jacobsen (w/attachments)
File: RFI Log
Project Manager: Chuck Stilwell (w/attachment)
Other: Ron Ziegler/ARCO; George Brooks/ARCO; Sally Dickerson/ARCO; Traci Blackwood/ARCO; Dick Talley/MSE-HKM (w/attachments); Todd Erickson/MSE-HKM; Scott Hurley/MSE-HKM; Barnard Construction (w/attachment); Ron Bertram/EPA; Ken Brockman/EPA (w/attachment); Larry Smith/EPA (w/attachment); Kevin Kirley/State of Montana; Nancy Dessenberger/ESA; Rick Larson/BSB; Pat Crowley/MDEQ Solid Waste.

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COMMUNITY SERVICES BUREAU

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

CONFIDENTIAL PRIVILEGED
ATTORNEY-CLIENT COMMUNICATION
ATTORNEY WORK PRODUCT PREPARED
IN ANTICIPATION OF LITIGATION

MEMORANDUM

To: Eric Jacobsen/ARCO
cc: Chuck Stilwell/ARCO; Brad Archibald/Pioneer Technical Services
From: Steve Pierce, Pioneer Technical Services Brad Archibald for STP
Date: April 30, 1997

Re: Adjustment of the Maximum Allowable Water Content for Disposing of Sandy LAO Tailings in Non-Structural Fill Areas of the Clark Tailings Site

As requested by ARCO and the construction contractor, Barnard Construction Company, Pioneer Technical Services, Inc., in conjunction with MSE-HKM, has assessed the possibility of increasing the maximum allowable water content for LAO tailings placed in non-structural fill areas of the Clark Tailings site. The contractor has excavated materials at LAO that have high moisture contents, and would like to be able to place and compact the materials at Clark Tailings without having to reduce the moisture content of the tailings to meet the construction requirements. Note that this memorandum addresses only the sandy tailings at the LAO site. The "marbled" mixture of tailings and peat located at the site is currently being analyzed and will be presented in a separate memorandum.

To address this request, samples of silty sand tailings were collected from four different areas of LAO by MSE-HKM and submitted to MSE-HKM's soils laboratory for testing. The samples collected represent as closely as possible the range of tailings materials present at LAO. Laboratory testing consisted of the following: grain size distribution; moisture-density (Standard Proctor); plasticity; and consolidation testing. Consolidation tests were completed at a dry density of 90 percent of the maximum and molding moisture contents of approximately 2, 4, and 6 percent over the optimum. Each sample was consolidated at 2,000 pounds per square foot of pressure. This consolidation pressure was selected because it approximates the average confining pressure that the tailings will be subjected to after placement and compaction at the Clark Tailings site.

0430EJ.MEM

100% post-consumer paper & 100% vegetable based inks

A summary of the laboratory test results is attached. The results of the laboratory testing indicates that the silty sand tailings present at LAO are generally poorly graded, non-plastic, and do not show significant variability in percent consolidation with increasing water content. The consolidation results suggest that there would be little difference in settlement of the fill when placed at moisture contents to at least 4 percent over optimum; several of the samples indicate that moisture contents up to 6 percent over optimum could be acceptable. However, poorly graded tailings at elevated moisture contents tend to pump and shift due to the weight of construction equipment during placement, making placement difficult and long-term integrity of the fill questionable.

Based on analysis of the laboratory tests and previous experience, we believe that the maximum allowable moisture content of the silty sand tailings can be increased to 4 percent over optimum during placement. Nevertheless, placement and compaction must be monitored continuously to ensure that the fill is not pumping or shifting laterally during construction. If unsuitable movement occurs, the material must be dried or mixed with drier material to reduce this behavior.

SUMMARY OF LABORATORY CONSOLIDATION TESTING FOR CONSOLIDATION POTENTIAL vs WATER CONTENT

LAO/CLARK TAILINGS CONSTRUCTION PROJECT

4/22/97
file: laocon2.wb2

Sample: GP 1163 & GP 769 Silty Sand (SM) Consol Data: Load = 2000 psf, DD = 90%

% Gravel	12
% Sand	73
%Fines	15
LL	NV
PI	NP

Max DD	119
Opt Wc	12

Wc above optimum	Percent Consol
2	1.4
4	1.6
6	1.8

Sample: GP 1409 & GP 812 Silty Sand (SM) Consol Data: Load = 2000 psf, DD = 90%

% Gravel	3
% Sand	60
%Fines	37
LL	NV
PI	NP

Max DD	104
Opt Wc	19.5

Wc above optimum	Percent Consol
3	3.1
4	5
6	4.3

Sample: GP 365 & GP 366 Silty Sand (SM) - #1 Consol Data: Load = 2000 psf, DD = 90%

% Gravel	0
% Sand	88
%Fines	12
LL	NV
PI	NP

Max DD	112.9
Opt Wc	11.4

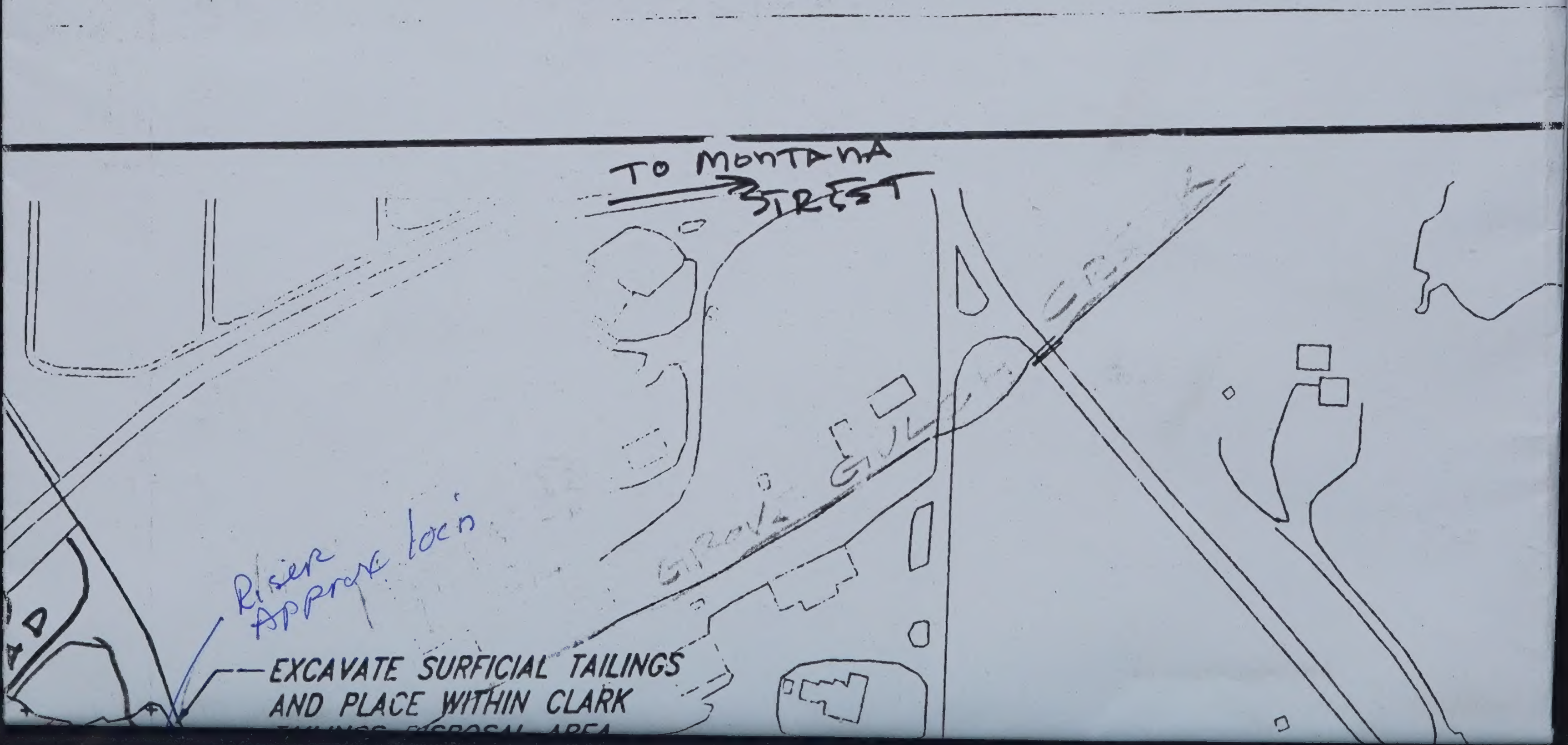
Wc above optimum	Percent Consol
1.7	1.9
3.8	2.3
6.6	2.2

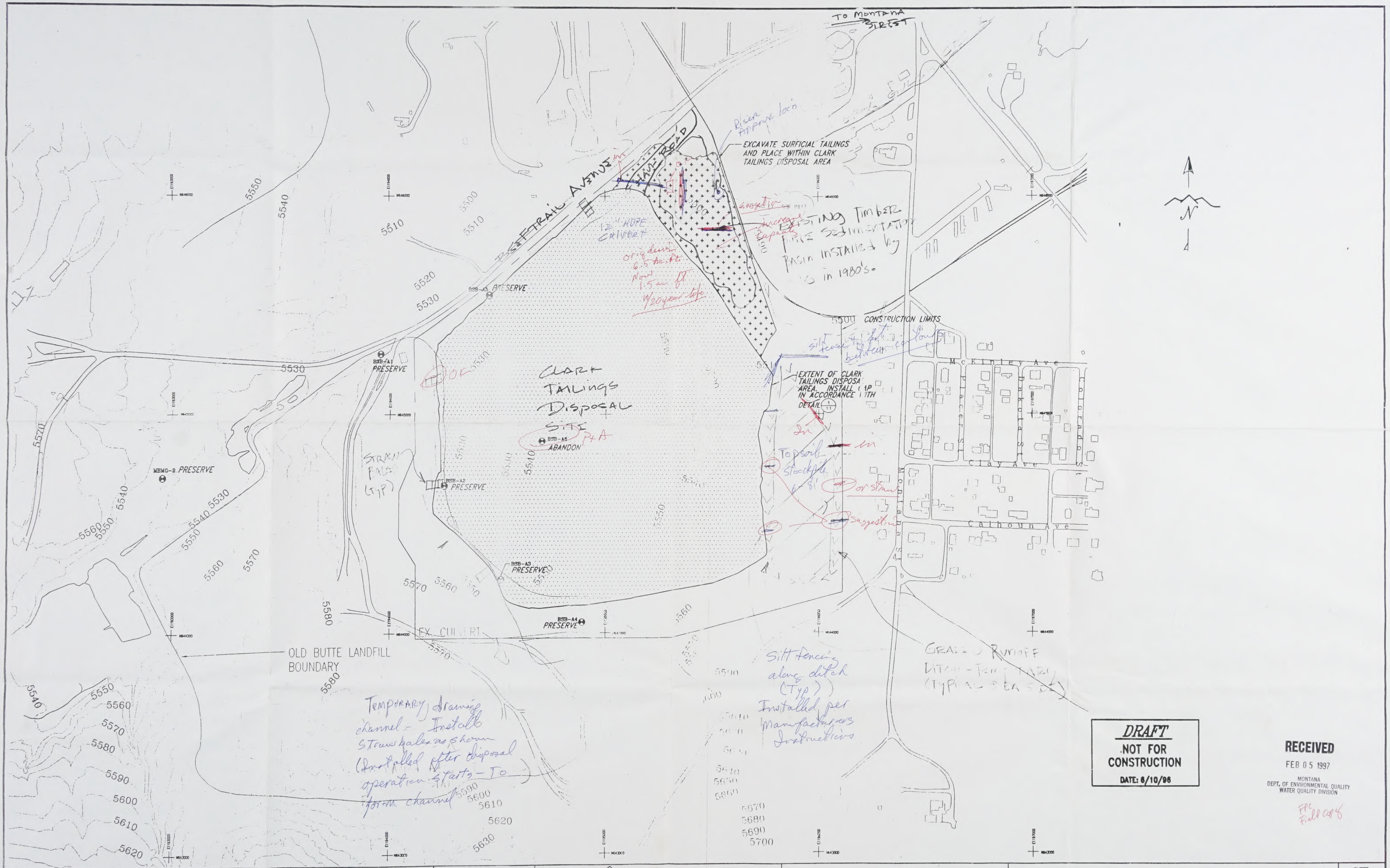
Sample: Sta 15+25, 125' lt Silty Sand Mine Tails (SM) Consol Data: Load = 2000 psf, DD = 90%

% Gravel	7
% Sand	75
%Fines	37
LL	NV
PI	NP

Max DD	116.6
Opt Wc	13.9

Wc above optimum	Percent Consol
1.9	2.4
4.1	2.9
6.4	5.2


TO MONTANA STREET
GROVE GULCH CREEK
Riser Approx loc'n
EXCAVATE SURFICIAL TAILINGS
AND PLACE WITHIN CLARK
TAILINGS DISPOSAL AREA


TO MONTANA STREET
EXCAVATE SURFICIAL TAILINGS AND PLACE WITHIN CLARK TAILINGS DISPOSAL AREA
Riser Approx locn
TRAIL AVENUE
HAUL ROAD
12" HDPE CULVERT
suggestion
increase capacity
EXISTING Timber PILE SEDIMENTATION BASIN INSTALLED by [illegible] in 1980's.
orig design 6.5 Ac-ft Now 1.5 ac ft W/20year life
BSB-A5 PRESERVE
5500 CONSTRUCTION LIMITS
silt fence 4 ft between contours
McKinley Ave
Placer St
Dakota St
Colorado St
Clay Ave
Calhoun Ave
Montana St
EXTENT OF CLARK TAILINGS DISPOSAL AREA. INSTALL CAP IN ACCORDANCE WITH DETAIL 1/11
In
in
Topsoil stockpile 6-8'
or straw
Suggestion
BSB-A1 PRESERVE
OK
CLARK TAILINGS DISPOSAL SITE
BSB-A6 ABANDON
P&A
STRAW BALES (TYP)
BSB-A2 PRESERVE
MBMG-2 PRESERVE
BSB-A3 PRESERVE
BSB-A4 PRESERVE
EX. CULVERT
OLD BUTTE LANDFILL BOUNDARY
Temporary drainage channel - Install Strawbales as shown (Installed after disposal operation starts - To form channel)
Silt fencing along ditch (Typ) Installed per Manufacturers Instructions
GRADED RUNOFF DITCH - TRIBUTARY (TYPICAL @ EA SIDE)
N
5500
5510
5520
5530
5540
5550
5560
5570
5580
5590
5600
5610
5620
5630
5640
5650
5660
5670
5680
5690
5700
E1193000
E1194000
E1195000
E1196000
E1197000
N646000
N645000
N644000
N643000

DRAFT
NOT FOR CONSTRUCTION
DATE: 6/10/96

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FEB 05 1997
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WATER QUALITY DIVISION

FPC
Field copy

4502-2

NO.	BY	DATE	REVISION DESCRIPTION

PJS DRAWN	BOA DESIGNED	SDB CHECKED
BOA APPROVED	6/5/96 DATE	4502 PROJECT NO.

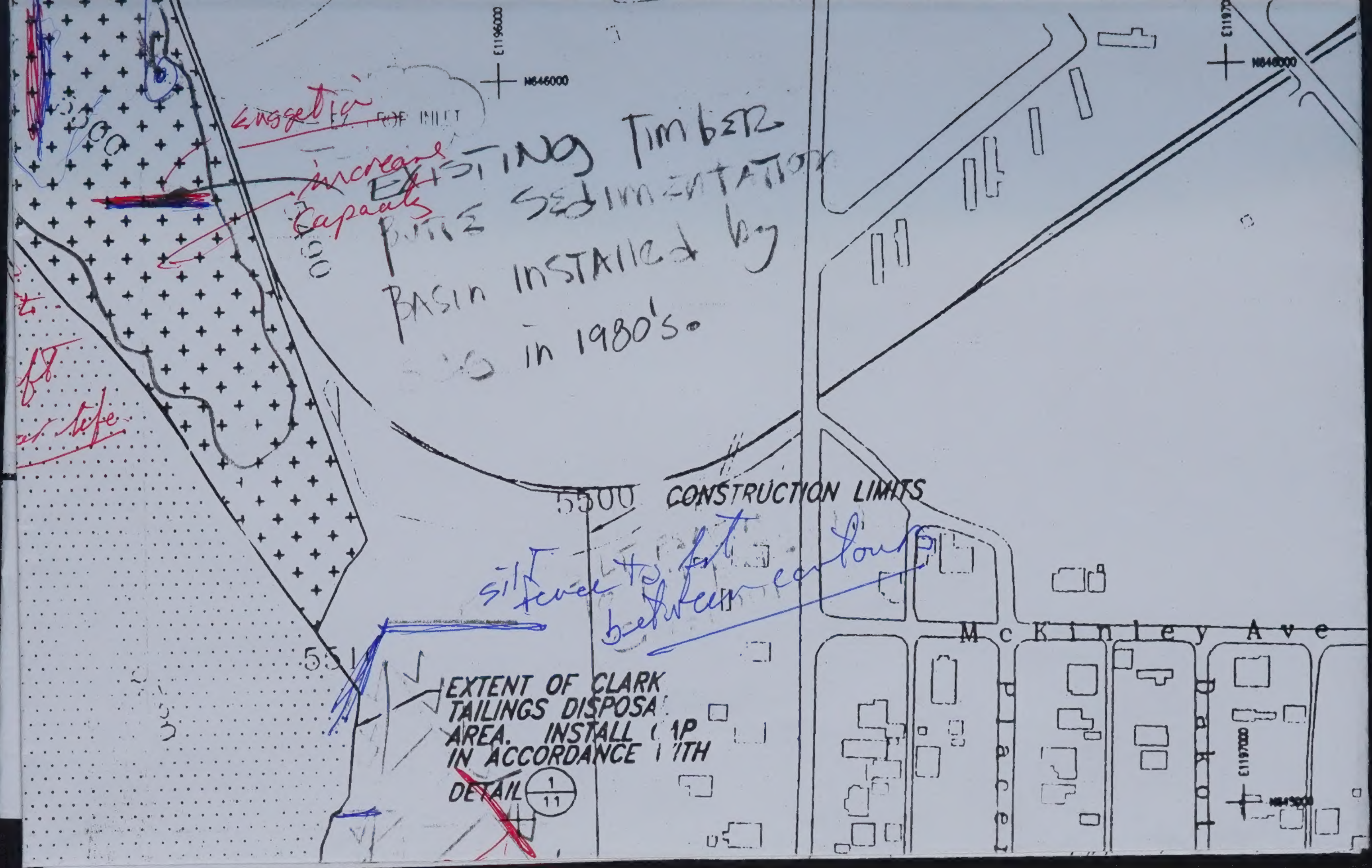
SCALE
HORIZ: 1"=200' VERT: NA
SCALE IN FEET
0 200 400

PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3445
BUTTE, MT 59702

ARCO
LAO/CLARK TAILINGS
DISPOSAL AREA

SITE MAP AND
CAPPING PLAN

SHEET
C-2

E1196000
N646000
E1197000
N646000
suggestion
~~POP INLET~~
increase capacity
EXISTING Timber BUTTE SEDIMENTATION BASIN INSTALLED by in 1980's.
5500
CONSTRUCTION LIMITS
silt fence to fit between contours
551
EXTENT OF CLARK TAILINGS DISPOSA AREA. INSTALL AP IN ACCORDANCE ITH DETAIL 1/11
McKinley Ave
Placer
Dakot
E1197000
N645000
ft.
life

DEPARTMENT OF ENVIRONMENTAL QUALITY
PERMITTING & COMPLIANCE DIVISION
STORM WATER PROGRAM
MARC RACICOT, GOVERNOR
Metcalf Building

STATE OF MONTANA

Phone: (406)444-4323
Fax: (406)444-1374
PO Box 200901
Helena, MT 59620-0901I

June 24, 1997

Chuck Stillwell
Clark Tailings Project Manager
ARCO
307 East Park Street
Anaconda, MT 59711

Dan S. Schall
Barnard Construction
P.O. Box 99
Bozeman, MT 59771-0099

Dear Sirs:

It has come to the attention of the department that discharges from the construction project covered under permit # MTR 100371 at the Clark Tailings in Butte, MT may potentially contain metals in the discharge waters. According to Part IV, Section Q, Reopener Provision, (page 17) of your General Discharge Permit for Storm Water Associated with Construction Activity, the Department has the authority to modify the permit to include different limitations and/or requirements if there is evidence indicating potential or realized impacts on water quality due to any storm water discharge associated with the construction activity.

Because of the material involved in the construction activity, Barnard Construction is hereby required to sample all future storm water discharges from the site to Grove Gulch Creek for the following:

Copper, Total and Dissolved
Lead, Total and Dissolved
Zinc, Total and Dissolved
Cadmium, Total and Dissolved
Arsenic, Total and Dissolved

The point of sampling may either be at the sedimentation pond down drop inlet or at the point where Grove Creek emerges from beneath the tailings dam. In the event that the latter point is chosen, you may wish to sample the creek prior to its entrance to the diversion pipe in order to determine background values of the receiving water.

"AN EQUAL OPPORTUNITY EMPLOYER"

Old Butte l.f.
Closure
+
Corr Measures

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

May 13, 1997

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MAY 14 1997
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DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

Mr. F. Patrick Crowley
Montana Department of Environmental Quality
Permitting and Compliance Division
P.O. Box 200901
Helena, MT 59620-0901

Dear Pat:

Enclosed for your review are the draft design drawings for the passive landfill gas venting system at the Old Butte-Silver Bow Landfill. This venting system is in accordance with the preferred alternative in *the Final Draft, Butte-Silver Bow Landfill/Clark Tailings Corrective Measures Assessment* (January 1997).

As we discussed on the phone, Butte-Silver Bow would like to begin installation of the gas venting system next week. Installation of the cap for the portion of the landfill that received waste after October 9, 1991 would follow installation of the venting system. This cap would be installed in accordance with the preferred alternative in the corrective measures assessment and the Construction Quality Assurance Plan for the Old Butte-Silver Bow Landfill Final Cover Installation (January 1996), which was submitted to you previously.

Feel free to give me a call at 782-5177 with any questions or concerns you may have regarding this plan.

Sincerely,

Brad Archibald

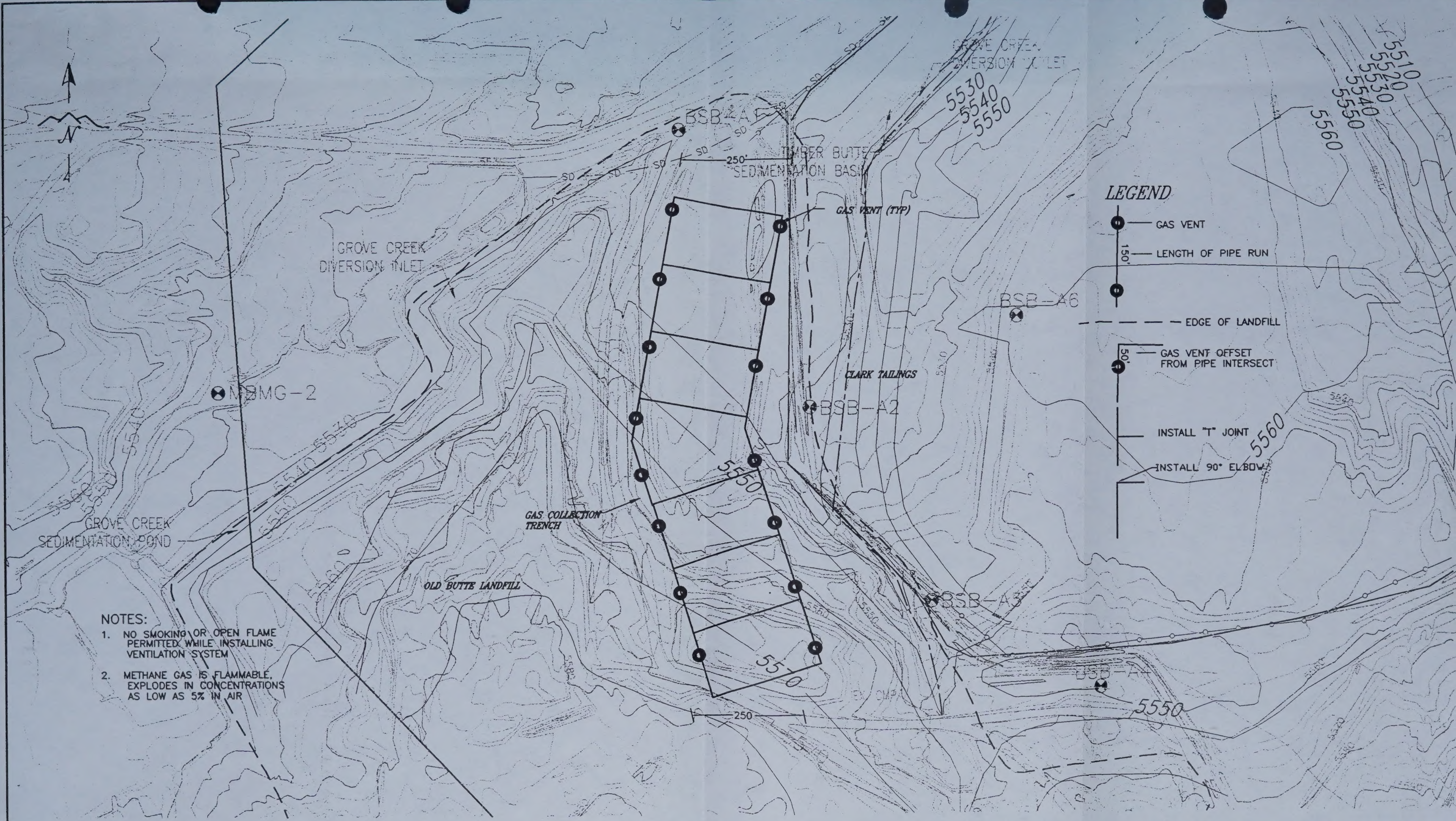
Brad Archibald, P.E.
Senior Engineer

Encl.

cc: Jim Johnston, Butte-Silver Bow
Gary Keeler, Butte-Silver Bow

County Silver Bow
Facility & # Butte 20
[✓ Closure]
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Landfarm
Liner
Methane
O & M
Run - On
Other:
4-3

100% post-consumer paper & 100% vegetable based inks


N
BSB-A1
SD
250'
TIMBER BUTTE
SEDIMENTATION BASIN
GROVE CREEK
DIVERSION OUTLET
5530
5540
5550
5510
5520
5560
GAS VENT (TYP)
GROVE CREEK
DIVERSION INLET
BSB-A6
CLARK TAILINGS
MBMG-2
BSB-A2
GAS COLLECTION
TRENCH
GROVE CREEK
SEDIMENTATION POND
OLD BUTTE LANDFILL
BSB-A3
BSB-A4
LEGEND
GAS VENT
150'
LENGTH OF PIPE RUN
EDGE OF LANDFILL
50'
GAS VENT OFFSET
FROM PIPE INTERSECT
INSTALL "T" JOINT
INSTALL 90° ELBOW

NOTES:
1. NO SMOKING OR OPEN FLAME PERMITTED WHILE INSTALLING VENTILATION SYSTEM
2. METHANE GAS IS FLAMMABLE, EXPLODES IN CONCENTRATIONS AS LOW AS 5% IN AIR

DRAFT

NO.	BY	DATE	REVISION DESCRIPTION

LT DRAWN — DBC DESIGNED — BOA CHECKED
APPROVED — 5/7/97 DATE — 9503 PROJECT NO.

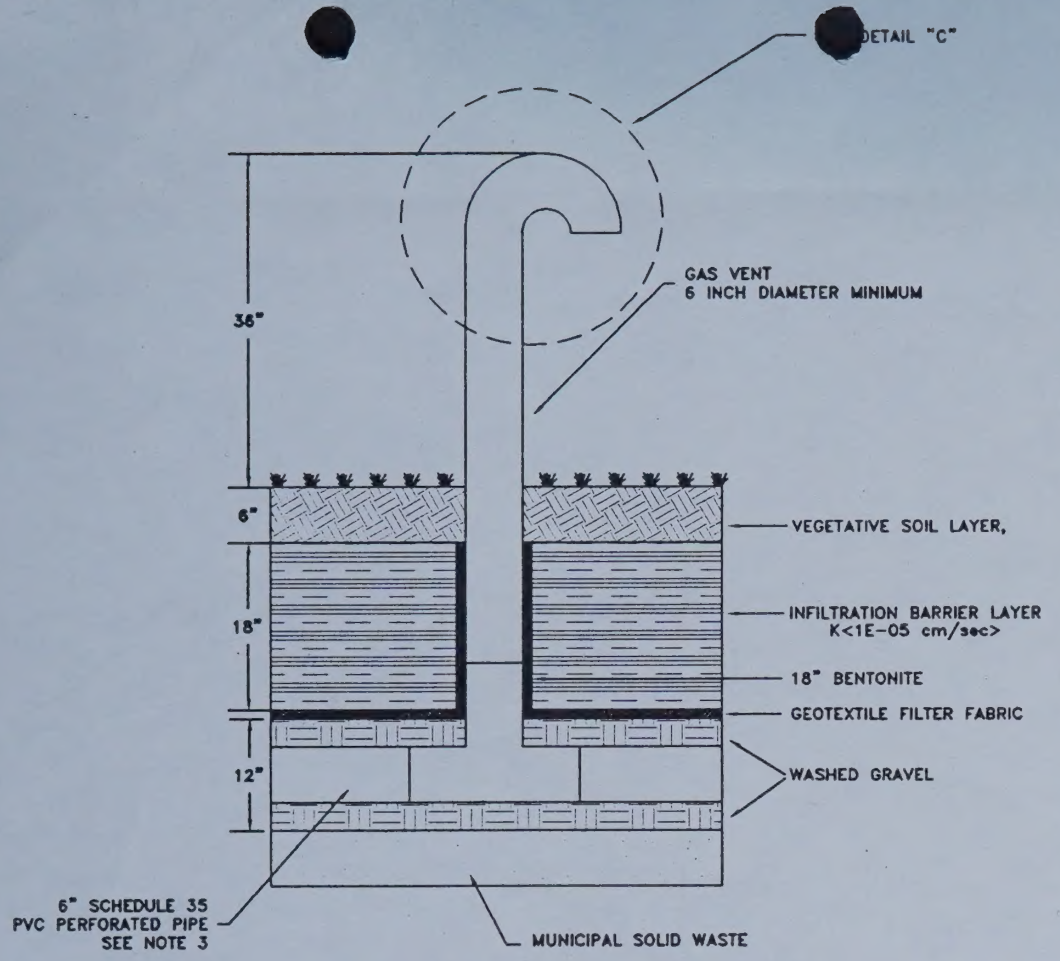
SCALE
HORIZ: 1"=200' VERT: 1"=5'
SCALE IN FEET
0

PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3446
BUTTE, MT 59702

BUTTE-SILVERBOW
OLD SILVER BOW LANDFILL
LANDFILL GAS VENTING

LANDFILL GAS VENTING PLAN

SHEET
1


DETAIL "C"
GAS VENT
6 INCH DIAMETER MINIMUM
36"
6"
18"
12"
VEGETATIVE SOIL LAYER,
INFILTRATION BARRIER LAYER
K<1E-05 cm/sec>
18" BENTONITE
GEOTEXTILE FILTER FABRIC
WASHED GRAVEL
6" SCHEDULE 35
PVC PERFORATED PIPE
SEE NOTE 3
MUNICIPAL SOLID WASTE

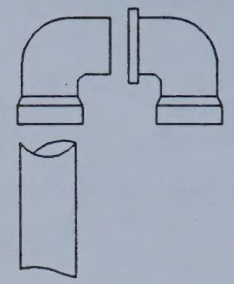
DETAIL A
GAS VENT

SEE NOTE 1, 2, 3.
(NOT TO SCALE)

NOTES:

1. GAS COLLECTION PIPES SHALL CONSIST OF 20 FT. LENGTHS OF STANDARD 6 INCH BELLED END PVC PERFORATED PIPE. ALL JOINTS SHALL BE ASSEMBLED SIMPLY BY APPLYING PRIMER AND CEMENT AND PUSHING THE ENDS OF THE PIPE TOGETHER. PIPES SHALL BE BEDDED IN THE CENTER OF THE 1.0 FT DRAIN ROCK LAYER.
2. THE DRAIN ROCK LAYER (3 FT. WIDE, 1 FT. DEEP, 1:1 SLOPE) WHICH SHALL BE INSTALLED APPROXIMATELY 24 IN. UNDER THE LANDFILL CAP. FILTER FABRIC (8 FT. WIDE) SHALL BE LAYED OVER THE TOP OF THE DRAIN ROCK LAYER AFTER THE CAS COLLECTION PIPE IN INSTALLED.
3. THE GAS VENT WHICH IS MADE OF THREE PIECES OF PVC PIPE (4 FT. STRAIGHT PIPE AND 2 - 6IN. - 90 DEGREE ST. ELBOWS) SHALL BE CONNECTED TO THE GAS COLLECTION PIPE BY A T-JOINT. THE GAS VENT SHALL BE APPROXIMATELY 5 FT. IN VERTICAL LENGTH (3 FT. IS ABOVE GROUND). A 6 IN. LAYER OF BENTONITE SHALL BE POURED AROUND THE CIRCUMFERENCE OF THE VENT PIPE WHERE IT INFILTRATES THE FILTER FABRIC.

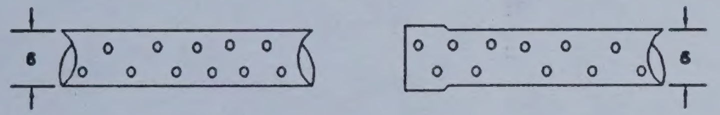
DRAFT



DETAIL "C"
GAS VENT U-BEND

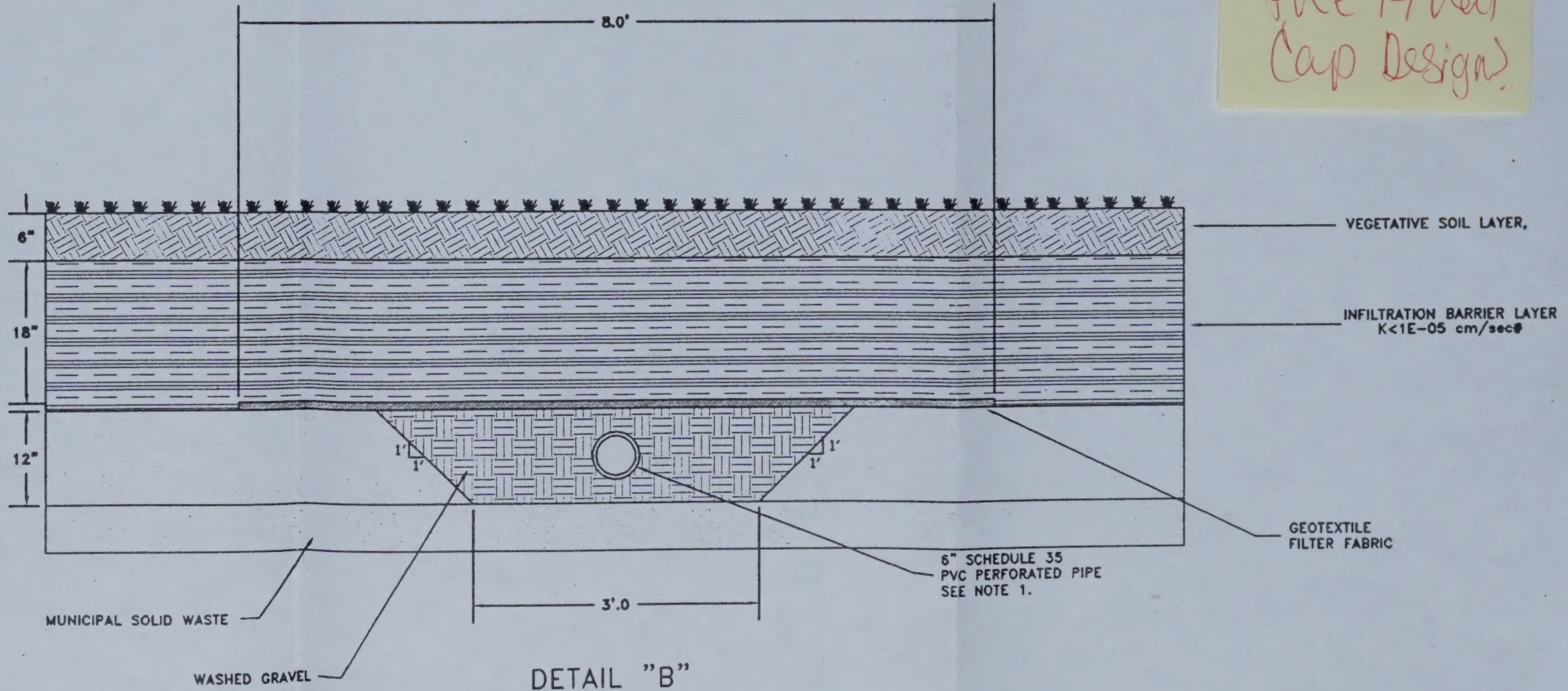
SEE NOTE 3

IS This the Final Cap Design?



DETAIL "D"
GAS COLLECTION PIPE DETAIL

SEE NOTE 1


8.0'
6"
18"
12"
1'
1'
1'
1'
VEGETATIVE SOIL LAYER,
INFILTRATION BARRIER LAYER
K<1E-05 cm/sec
GEOTEXTILE
FILTER FABRIC
6" SCHEDULE 35
PVC PERFORATED PIPE
SEE NOTE 1.
3'.0
MUNICIPAL SOLID WASTE
WASHED GRAVEL

DETAIL "B"
GAS VENT TRENCH CROSS-SECTION

(NOT TO SCALE)

4502-E21

NO. BY DATE REVISION DESCRIPTION

LT DRAWN
DRC DESIGNED
BOA CHECKED
APPROVED
2/21/97 DATE
PROJECT NO.

SCALE
HORIZ: N. T. S. VERT: N. T. S.
SCALE IN FEET
0 N. T. S.

PIONEER TECHNICAL SERVICES, INC.
P.O. BOX 3446
BUTTE, MT 59702

BUTTE-SILVER BOW
OLD SILVER BOW LANDFILL
LANDFILL GAS VENTING

TRENCH AND VENT DETAILS

SHEET
2

County Silver Bow
Facility & # Butte 20
[✓ Closure]
Finan Assur
GW Corr Meas
GW Monitoring
GW Reports
Inspections
Other:
Landfarm
Liner
Methane
O & M
Run - On

4-3

BUTTE-SILVER BOW
DEPARTMENT OF PUBLIC WORKS
Courthouse
Butte, Montana 59701
Phone: (406) 723-8262

RECEIVED
APR 21 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

April 18, 1997

Mr. Patrick Crowley
Acting Program Manager
Department of Environmental Quality
P.O. Box 200901
Helena, Montana 59620-0901

Dear Pat:

You are advised that the Old Butte-Silver Bow landfill license No. 20 stopped accepting waste prior to April 9, 1997. 1994 PPC

Final cover will be placed this spring in compliance with the Corrective Measures Assessment and the final 7 acres will be covered.

I have calculated the environmental obligation for closure of the old landfill from the attached Table 6-10 from the Butte-Silver Bow Corrective Measures Assessment which details the anticipated annual post closure monitoring and maintenance costs amount to $31,900. Also, Butte-Silver Bow is responsible for installing a passive gas venting and the engineering estimate is in the amount of $62,000 is highlighted on the attachment. As you know, the landfill cover is almost complete and the majority of the final cover is in place awaiting seeding this fall.

I will await your response to the Butte-Silver Bow Financial Assurance Mechanism that was submitted.

Thank you for your assistance.

Sincerely,
Gary Keeler

Gary Keeler
Landfill Manager

TABLE 6-10

PRELIMINARY COST ESTIMATE - ALTERNATIVE 8
LANDFILL GAS REMOVAL WITH LOW PERMEABILITY CAPPING AND INSTITUTIONAL CONTROLS

	Quantity	Units	Unit Price	Cost	Unit Cost Reference
CAPITAL COSTS					
Mobilization, Bonding, and Insurance	1	L.S.	30000	30000	Estimate
Clark Tails Consolidation, Site Prep.	13000	cy	5	65000	Estimate
Clark Tailings Infil. Barrier Layer	52	Acres	9000	468000	Bid Tabulations
Clark Tailings Capillary Break Layer	52	Acres	10000	520000	Bid Tabulations
Clark Tailings Cover Soil	52	Acres	7500	390000	Bid Tabulations
Construct Pre-1991 Landfill Cap	3	Acres	7500	22500	Bid Tabulations
Construct Post-1991 Landfill Cap	4	Acres	11700	46800	Bid Tabulations
Install Passive Gas Venting	20	Acres	3100	62000	MDEQ, 1996 ✓
Organic Amendment	122	Acres	500	61000	Schaefer
Fertilize, Seed, and Mulch	122	Acres	1500	183000	Schaefer
Lined Run-on Control Pond	1	L.S.	90000	90000	Estimate
Surface Water Diversions	5500	L.F.	8	44000	MDEQ Bid Tabulations
Institute Land Use Restrictions	1	L.S.	5000	5000	Estimate
Institute Controlled Groundwater Use Zone	1	L.S.	50000	50000	Estimate
Subtotal				2037300	
Engineering / Construction Oversight (15%)				305595	
Subtotal Capital Costs				2342895	
Contingency (10%)				234290	

TABLE 6-10 Continued

TOTAL CAPITAL COSTS	**$2,577,185**

POST CLOSURE MONITORING AND MAINTENANCE COSTS					
Inspections	2	/Year	500	1000	Estimate
Groundwater Monitoring - Sampling and Analysis	12	Samples	1500	18000	Experience
Maintenance	1	L.S.	10000	10000	Estimate
Subtotal				29000	
Contingency (10%)				2900	
ANNUAL 30 YEAR O&M COST				**$31,900**	

TOTAL CAPITAL COSTS	2577185
PRESENT WORTH, POST-CLOSURE MAINTENANCE AND MONITORING (5%)	490381
TOTAL PRESENT WORTH COST	**$3,067,566**

Corporate Environmental Remediation
ARCO

RFI - REQUEST FOR INFORMATION

DATE 4/17/97	RFI NO. 29 INITIATED BY: ARCO	CONTRACTOR Barnard Construction	CONTRACT NO. M96532

CONTRACT DESCRIPTION: LAO Phase I, Segment II Excavation and Clark Tailings Disposal	ATTENTION OF: Barnard/MDEQ

SUBJECT:
○ ELECTRICAL ○ MECHANICAL ● CIVIL ○ STRUCTURAL/ARCHITECTURAL ○ INSTRUMENTATION

OPERABLE UNIT: LAO MAJOR WORK TASK: Phase I, Segment II Construction WBS NUMBER:	REFERENCE DWG., P.O., TAG, SPECIFICATION NO. (FOR DEVIATIONS OR DEFICIENCIES) ETC: Attached memo from Brad Archibald (Pioneer Technical).

PROBLEM/CHANGE DESCRIPTION:

Haul truck travel over the existing Clark Tailings subgrade and on temporary construction haul roads at Clark Tailings is currently difficult due to several potential factors. Seasonal constraints (i.e., above average precipitation, frost working out of the ground, etc.) create difficult construction conditions. Barnard continues to attempt to dry many of the wet areas on site. Also, some of the "marbled" LAO material (i.e., mixed peat/clay and tailings) placed on haul roads and in compacted areas makes construction travel difficult. ARCO and Pioneer Technical have designated "marbled" fill areas outside the LAO fill footprint, but inside the Clark Tailings cap area, where Barnard may place "marbled" fill in 15" loose lifts with no compaction required other than tracking with dozing equipment. Finally, some of the subgrade at Clark Tailings contains a large fraction of extremely fine materials (e.g., #200 mesh) which "pump" when traveled by construction traffic.

In light of these difficulties, Pioneer Technical has allowed a temporary variance in the fill placement specification as stated in the attached memo from Brad Archibald. The intent of the variance is to facilitate construction traffic across the subgrade without sacrificing the structural integrity of the Clark Tailings fill. Where lift thickness is increased per Brad Archibald's memo, Barnard has agreed to use standard compaction equipment (i.e., a roller) to compact the lifts even if the lift is in a 90% compaction area. The variance is temporary and shall only be utilized when needed.

	○ Design Deficiency ○ Engineering Change Request ○ Agency Directive ○ Construction Deficiency ○ Schedule	○ Material Substitution ○ Vendor Material Deficiency ○ Scope ○ Clarification/Information ○ Other ______	ARCO Representative: 4/18/97

RESPONSE/DIRECTIVE:

CC: : Construction Supervisor: Eric Jacobsen (w/attachments)
File: RFI Log
Project Manager: Chuck Stilwell
Other: Ron Ziegler/ARCO; George Brooks/ARCO; Sally Dickerson/ARCO; Traci Blackwood/ARCO; Dick Talley/MSE-HKM (w/attachments); Todd Erickson/MSE-HKM; Scott Hurley/MSE-HKM; Barnard Construction (w/attachment); Ron Bertram/EPA; Ken Brockman/EPA (w/attachment); Larry Smith/EPA (w/attachment); Kevin Kirley/State of Montana; Mark Hills/CDM; Nancy Dessenberger/ESA, Rick Larson/BSB; Pat Crowley/MDEQ Solid Waste

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APR 24 1997
MONTANA
DEPT. OF ENVIRONMENTAL QUALITY
COMMUNITY SERVICES BUREAU

PIONEER
TECHNICAL SERVICES, INC.
P.O. BOX 3445, BUTTE, MONTANA 59702 PHONE (406) 782-5177 FAX (406) 782-5866

MEMORANDUM

CONFIDENTIAL
PRIVILEGED ATTORNEY-CLIENT COMMUNICATION
ATTORNEY WORK PRODUCT
PREPARED IN ANTICIPATION OF LITIGATION

DATE: April 18, 1997

TO: Eric Jacobsen, ARCO

FROM: Brad Archibald, P.E. BCA

RE: Lift Thickness at Clark Tailings

Due to difficulties with traffic causing pumping of the subgrade at the Clark Tailings, you have asked me to consider increasing the allowable lift thickness when placing the LAO materials at the site.

The existing allowable lift thickness for structural and non-structural fill is 12 inches loose thickness. In the interest of minimizing the effects of traffic on the existing subgrade, the allowable lift thickness for the initial lifts may be increased so that the maximum compacted thickness is not greater than 12 inches. This variation in the specification would apply for the initial three lifts or until pumping of the subgrade is no longer apparent, whichever is less. This is allowable only if MSE-HKM is confident that they will be able to measure moisture and density through the entire thickness of the compacted lift.

In addition to this, other means to minimize pumping of the subgrade should also be employed, as we have discussed. These include minimizing truck traffic over the subgrade; temporarily stopping work in areas that begin to deflect as a result of construction traffic; and minimizing vibratory compaction over suspect areas (possibly including the use of a static sheepsfoot compactor instead of a smooth drum vibratory compactor).

ARCO

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